Filing Code 6500
Date Issued May 1980
Technical Note # 340

TECHNICAL NOTE

U.S. DEPARTMENT OF THE INTERIOR – BUREAU OF LAND MANAGEMENT

CHEMICAL RESTRAINT OF REPTILES, AMPHIBIANS, FISH, BIRDS, SMALL MAMMALS AND SELECTED MARINE MAMMALS IN NORTH AMERICA.

(An Annotated Bibliography)

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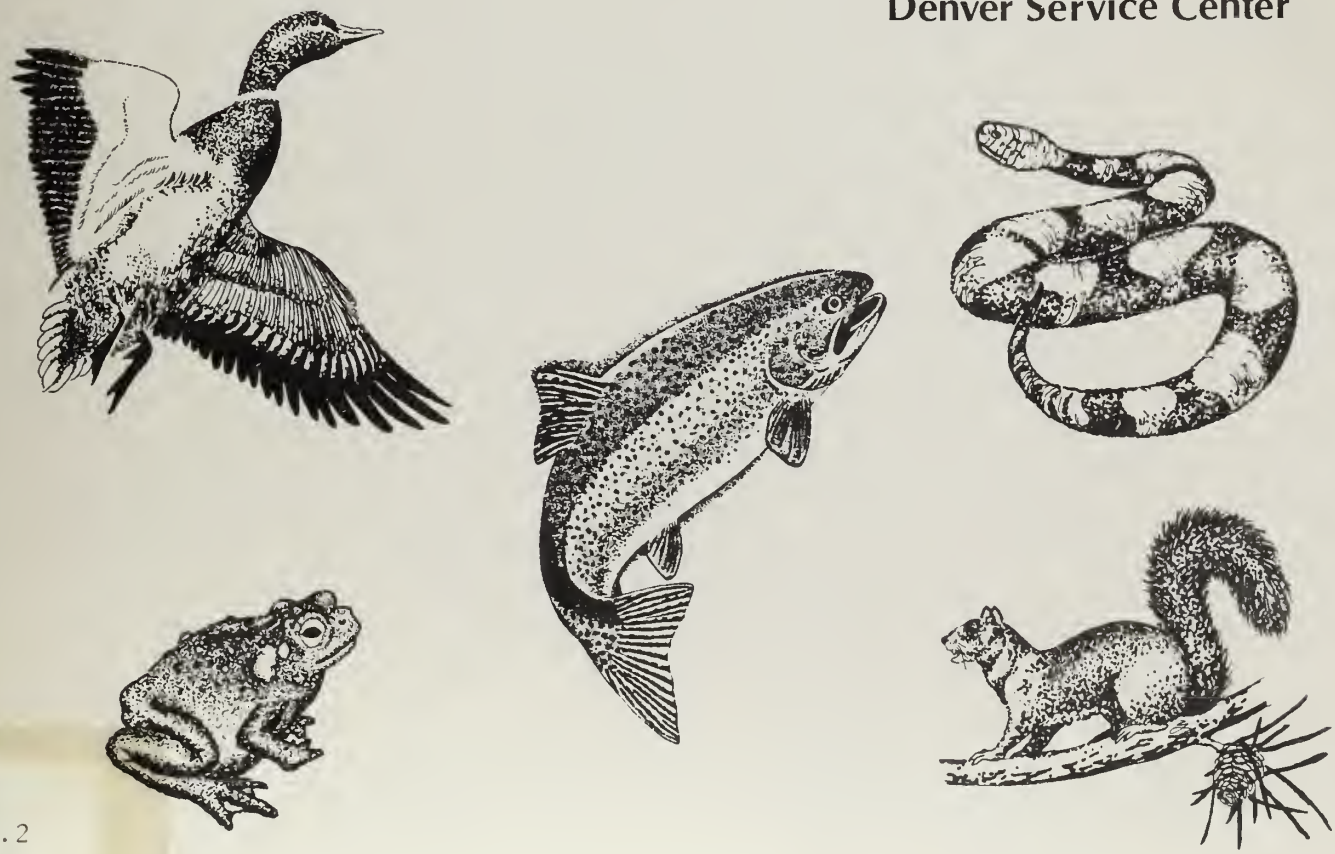

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OF

SMALL ANIMALS AND DRUGS

INTRODUCTION

This annotated bibliography provides a list of available literature sources on anesthetizing or immobilizing small animals. Although the original intent of this bibliography was to deal strictly with small wild animals, it was expanded to include listings on many laboratory animals such as rabbits, rats, and mice. Extensive testing and research on these animals has led to better methods in handling, anesthetizing, and immobilizing. For these reasons, it is hoped that the procedures and methods obtained in the laboratory may apply to the welfare, well-being, and management of wild animal populations.

Information has also been included on repellents, as they too are a form of chemical restraint. However, it is not a complete list and many more sources do exist.

In this bibliography, a small animal is defined as one which is smaller than a wild pig. Selected references are included for marine mammals. In some instances, reptile and amphibian species not found in North America are reported due to the general lack of knowledge on these groups.

The publications are listed alphabetically by the author's last name. The use or mention of trade names or products does not constitute an endorsement by the Bureau of Land Management.

The annotations include drug dosages and some handling techniques. This information is given only to guide the reader to appropriate literature; it should not be used as a dosage reference by itself.

Some abstracts were quoted directly from the source material.

LOCATION OF LITERATURE

Unpublished reports of work done by State agencies under the Federal Aid in Fish and Wildlife Restoration Program (Dingell-Johnson/Pittman Robertson Acts) are included in this bibliography. These reports have notations such as (DPL-FWRS 21-2469438) in the citation. This work may be obtained by writing or calling:

Denver Public Library
Fish and Wildlife Reference Service
3840 York Street
Denver, Colorado 80205
(303) 571-4656

Reports of work done at the Cooperative Fish and Wildlife Research Unit may also be obtained from the above address.

In some cases these reports may be obtained directly from the State that did the work. The State agencies' addresses are listed alphabetically in Appendix A.

Articles harder to find are on file at the Bureau of Land Management Library (Bldg. 50, Denver Service Center, Denver, Colorado 80225). Those reports have the notation (BLM Library) after the citation.

Most of the citations were obtained at college and public libraries, some of which are listed in Appendix B.

1 ALLEN, John L., and Paul D. Harman. 1970. Control of pH in MS-222 anesthetic solutions. Prog. Fish Cult. Vol. 32, no. 2, p. 100.

When MS-222 (tricaine methanesulfonate) is added to soft water, the pH of the solution is depressed in relation to the concentration of MS-222. Anesthetic solutions can be maintained near neutral by the addition of 2 ppm of sodium bicarbonate for each part per million of MS-222, avoiding the sharp reductions of pH which often cause fish to show signs of irritation or intolerance. The pH of the anesthetic solutions should be determined before buffering with sodium bicarbonate as concentrated stock solutions will precipitate out. Also, hard water may not need sodium bicarbonate due to the buffering capacity of the dissolved salts in the water.

2 ALLEN, John L., and Joe B. Sills. 1973. Preparation and properties of quinaldine sulfate, an improved fish anesthetic. No. 47. In Investigations in Fish Control. U.S. Dept. of Interior, Bur. Sport Fish. & Wildl. 6 pp.

The preparation of quinaldine sulfate ($QdSO_4$) from practical grade quinaldine and sulfuric acid yields a crystalline product which is water soluble and easily purified by recrystallization. The product conforms with the empirical formula $C_{10}H_{11}NSO_4$ and assays 99.4 percent pure by titration. The crystalline material has little odor and is water soluble; thus, it is less objectionable and much easier to handle than quinaldine for anesthetizing fish.

3 ALLEN, John L., Charles W. Luhning, and Paul D.zHarman. 1972. Residues of MS-222 in northern pike, muskellunge, and walleye. No. 45. In U.S. Dept. of Interior, Bur. Sport Fish. & Wildl., Investigations in Fish Control. Pp. 3-8.

Residues of MS-222 (tricaine methanesulfonate) in muscle tissue of northern pike, muskellunge, and walleye following anesthesia were measured by a modified Bratton-Marshall colorimetric method and confirmed by thin-layer chromatography. The residues dissipate rapidly from the muscle when fish are withdrawn from the anesthetic and are near the background readings of the controls within 24 hours.

4 ALLEN, Kenneth E. 1965. Immobilizing beaver with succinylcholine chloride. Game Research in Ohio. Vol. 3, pp. 215-220. (DPL-FWRS 34-7520280).

Attempts were made to immobilize live trapped beaver (Castor canadensis) for sexing using succinylcholine chloride (Sucostrin). Sixteen separate injections were made on 9 different beaver without fatality. Dosages of 0.211-0.236 mg/lb gave the best results.

5 ALLISON, Leonard N. 1961. The effect of tricaine methanesulfonate (MS-222) on the motility of brook trout sperm. Prog. Fish Cult. Vol. 23, no. 1, pp. 46-47.

During spawn taking, tricaine methanesulfonate (MS-222) was used to anesthetize brood-stock lake trout at the State fish hatchery at Marquette, Michigan, and brook and brown trout at the State fish hatchery in Grayling, Michigan. There was a high mortality of eggs at Marquette, while at Grayling a good hatch resulted. Many reasons for the high mortality level were suspected; however, it was generally felt that the answer was in the concentration of anesthetic used. A concentration of 2 g of MS-222 to 7 gal of water was used at Grayling and 4 g to 7 gal at Marquette. Through many tests, it was determined that MS-222, when used at dilutions of 18.9 ppm, or stronger, made spermatozoa immobile. This dilution is one-fourth the strength of the solution generally recommended and one-eighth of that used which caused the high mortality of fish at Marquette. Thus, it was found extremely important that solutions containing MS-222 be kept from contacting the reproductive portions of the fish's body during spawn taking.

6 ALMANDARZ, E. 1978. "Chemical restraint and anesthesia." In Zoo and Wild Animal Medicine. Murray E. Fowler, Ed. W.B. Saunders Co. Philadelphia. Pp. 132-134.

A guide to the selection and use of chemical agents for restraint and anesthesia of reptiles. The use of injectable and volatile anesthetics are discussed. Ketamine hydrochloride is the author's drug choice for anesthetizing reptiles. Barbiturates are not recommended. Drug dosages are included.

7 AMAND, Wilbur B. 1974. Avian anesthesia. In Current Vet. Therapy V-Small An. Practice. Robert W. Kirk, Ed. Pp. 574-579.

Due to the popularity of keeping birds as pets, there has been an increased need in their care. There also needs to be a satisfactory means for anesthetizing these animals. This article reports the use of local, general, inhalant and injectable anesthesia in birds. Pre- and postanesthetic considerations along with what to do in an emergency are discussed.

8 ANDERSON, J.K. 1966. Lake investigations. Fish stocking. Dingell-Johnson Report, Kentucky, Proj. # F-026-R-01/WP-01/J-01. 4 pp. (DPL-FWRS 16-6940205).

Threadfin shad bass were introduced in lakes within Kentucky with the help of salt and MS-222. Successful results were obtained using 1 g of MS-222 and 1 lb of salt per 40 gal of water when travel time was less than 4 hours. When travel time was greater than 4 hours, 1 g of MS-222 and 1 1/2 pounds of salt per 40 gal of water were necessary. The techniques used to catch the fish and the threadfin shad collecting apparatus used are discussed within this report.

9 ANDREWS, Richard D. 1964. Effects of tear gas on some mammals. J. Mammalogy. Vol. 45, no. 2, p. 321.

Tear gas was tried on several mammals to see if it would be a satisfactory means of forcing these animals from their dens. These animals included the opossum (Didlphis marsupialis), raccoon (Procyon lotor), striped skunk (Mephitis mephitis), grey fox (Urocyon cinereoargenteus) and woodchuck (Marmota monax). Tear gas was not considered a satisfactory means of forcing mammals from ground dens, as only the fox emerged from the confining cage constructed to simulate a ground den. Various degrees of tissue damage were noted in the opossum, raccoon, skunk, and woodchuck. The opossum died from alveolar emphysema which was probably caused by the tear gas.

10 ANONYMOUS. 1950. Urethane anesthetization. Prog. Fish Cult. Vol. 12, no. 4, p. 195.

Fishery workers with the Oregon State Game Commission,

studying the effects of urethane anesthetization, determined that 57.4 percent of fish that later recovered had been anesthetized with urethane. The chemical was considered beneficial to fish that required handling for tagging and the amount of time required for tagging was decreased by 31 percent. In addition, the Commission used urethane for the removal of adipose and right pelvic fins from 5,000 fall rainbow trout. Prior to clipping, the fish were administered with 0.5 percent urethane. The fish, which averaged 68 per pound, had a low mortality rate. The 4 percent mortality, which occurred at the time of clipping, was not considered due to use of the anesthesia.

11 ANONYMOUS. 1952. Chloretone used to anesthetize salmon fingerlings. Prog. Fish Cult. Vol. 14, no. 2, p. 78.

A technique to anesthetize salmon fingerlings was determined by the Salmon Cultural Laboratory of the Fish and Wildlife Service at Entiat, Washington. Fingerlings placed in a net suspended in 1:2,500 concentration of chloretone ceased to have swimming motions after 2-3 minutes and then laid on their sides. After measuring the fish, they were removed from the solution and placed into a second net. This second net was then placed in fresh water and the fish generally recovered in 3-8 minutes.

12 ANONYMOUS. 1953. Use of sodium amytal on fish in California. Prog. Fish Cult. Vol. 15, no. 4, pp. 190-191.

The California Department of Fish and Game used sodium amytal, a hypnotic type barbiturate, on fish with successful results. The chemical has been found very effective in calming fish. Since the fish remain calm, they require less oxygen and therefore need less water in transport. Only one-third to one-quarter the amount of water is needed in transporting fish when a half grain of the drug to the gallon is used. In addition, the carrying capacity of fish per gallon of water is greatly increased using sodium amytal. Once drugged, fish showed no visible effects of their treatment after several months of observation.

13 ANONYMOUS. 1953. Use of three anesthetics on juvenile salmon and trout. Prog. Fish Cult. Vol. 15, no. 2, p. 74.

Various concentrations of tricaine methanesulfonate, urethane, and chlorobutanol were tried as anesthetics on coho salmon, red salmon, and Dolly Varden trout. The following results were obtained: Tricaine methanesulfonate was used at a water temperature of 13°-17° C, with the most desirable concentration being 1:2,000 at a water temperature of 16° C. When applied in these concentrations, these chemicals anesthetized the fish in several minutes. No side effects were noted with the fish, even when they remained in the solution for a short time after being anesthetized. Low mortality was the general rule when using these chemicals in the concentrations mentioned. A 100 percent mortality was noted when the fish were anesthetized with tricaine methanesulfonate in a concentration of 1:10,000.

14 ANONYMOUS. 1954. Brown trout anesthetized with ether for spawn-taking. Prog. Fish Cult. Vol. 16, no. 4, p. 171.

Brown trout anesthetized with ether were found easier to handle while attempting to strip the fish of eggs or milt. Because the fish were more relaxed, the fish were easily stripped. The post-spawning mortality amounted to 5.6 percent in groups of fish anesthetized while the mortality rate was 35.4 without anesthesia. To prevent the sperm or eggs from being damaged from the ether, the trout taken from etherized water were rinsed in fresh water before they were stripped. Some of the disadvantages found using ether were its inflammability and the necessity of frequent additions to keep an effective concentration.

15 ANONYMOUS. 1957. Various drugs as aids in spawning rainbow trout. Prog. Fish Cult. Vol. 19, no. 1, p. 39.

The U.S. Fish and Wildlife Service during 1954 made trials of 5 drugs to determine their suitability as an aid in spawning rainbow trout. These drugs included: sodium amytal, tricaine methanesulfonate (MS-222), methyl pentynol, urethane, and chloretone. In each trial, one drug was used in spawning 12 females and 8 males, with a similar lot of fish used as a control. Sodium amytal was unsuitable due to its slow action. The other drugs worked relatively well, and no significant difference was noted in the percentile hatch associated with the various drugs. The trout appeared in good condition 75 days after spawning.

16 ANONYMOUS. (undated). Tricaine methanesulfonate; Anesthetic for immobilizing fish, frogs, toads, and other cold blooded animals. Crescent Research Chemicals, Inc. 7050 Fifth Avenue, Scottsdale, AZ 85251.

Trout, salmon, bass, sharks, tropical fish, goldfish, bluegills, bullheads, frogs, toads, salamanders, newts, and planaria worms were all anesthetized with tricaine methanesulfonate. The drug dosages and methods for anesthetizing these animals are described in this informative fact sheet.

17 APPLEMAN, Robert M. 1966. A device for restraining rabbits. Lab. An. Care. Vol. 16, no. 3, pp. 300-303, illus.

A restraining device has been designed for rabbits which permits intraperitoneal or intravenous injections to be given quickly by one person. The device consists of a tie-down board and a Vinylite sling with a central zipper flap. A description and procedure on how to use the device are included.

18 ARNALL, L. 1961. Anesthesia and surgery in cage and aviary birds. Vet. Rec. Vol. 73, pp. 139-142 (Part I); 173-178 (Part II); 188-192 (Part III); 237-241 (Part IV).

Part I gives a good general overview of the gaseous, volatile, and parenteral anesthetics that may be used in birds. Local anesthesia and general medical principles are also discussed. A regional outline of surgical conditions is presented in Part II, while Parts III and IV give a systematic outline of surgical conditions.

19 ARNALL, L. 1964. Aspects of anesthesia in cage birds. In Small Animal Anesthesia. Proc. Symp. organized by British Small An. Vet. Assoc. & the Univ. Fed. for An. Welfare; London, July, 1963. Oliver Graham-Jones, Ed. The Macmillan Co., New York Pp. 137-146.

Factors affecting the actions, variability, efficacy, safety, choice, and failures of anesthetic methods in cage birds are discussed. The author suggests that simple clinical and biochemical standards of normality be established for prognostic purposes in avian anesthesia.

20 AUSTIN, David H., Timmie E. Peoples, and Lovett E. Williams, Jr. 1972. Procedures for capturing and handling live wild turkeys. Proc. 26th Ann. Conf. SE Assoc. Game and Fish Comm. Pp. 222-236, illus.

Over a 23-year time span, techniques were developed by trial and error to capture wild turkeys (Meleagris gallopava) in Florida. A brief discussion on using orally administered drugs to capture turkeys is mentioned. The oral drugs used (alpha-chloralose, tribromoethanol, and methoxymol), the drug amounts, and capturing methods are evaluated. Also discussed are the methods and equipment for observing, handling, holding, banding, and releasing wild turkeys. Two tables are included: one evaluates the capturing methods, the other lists the equipment and supplies for trapping and handling.

21 BACKHOUSE, K.M. 1964. The anesthesia of marine mammals. In Small Animal Anesthesia, Proc. Symp. organized by British Small An. Vet. Assoc. Univ. Fed. for An. Welfare. Oliver Graham-Jones, Ed. The Macmillan Co., New York. Pp. 79-86.

The highly adapted marine mammals such as Cetacea (whales, porpoises, dolphins), Sirenia (sea cows), and Pinnipedia (seals, sea-lions, and walruses) have all followed widely different courses of specialization. Because of this, each group offers special problems on how the animal may or may not be anesthetized. A discussion on this subject matter (as well as a review of other research work performed on these marine mammals) are mentioned and described.

22 BAHR, Thomas G. 1972. Recording electrical activity from the lateral-line nerve in trout. Prog. Fish Cult. Vol. 34, no. 1, pp. 59-61.

While testing the effects of water-borne pollutants on the nervous system of rainbow trout (Salmo gairdneri), it became necessary to anesthetize and immobilize the fish. For five minutes, the fish were anesthetized in 100 mg of tricaine methanesulfonate per liter of water. An intramuscular injection of *d*-tubocurarine chloride - 20 mi-per-kilogram live weight - immobilized the fish. For approximately 24 hours, the drug dosage of curare was effective and additional injections were administered as needed. The fish were kept wet, allowing aerated water into the mouth and over the gills.

23 BAILEY, J.E. 1958. Comparing survival, growth, and condition of wild trout and hatchery rainbow trout reared on two different diets. Dingell-Johnson Report, Montana, Proj. # F-013-R-04/J-01. 16 pp. (DPL-FWRS 25-6840810).

Three anesthetics, urethane, tricaine methanesulfonate (MS-222), and chloretone, were used during tagging operations of rainbow trout. The now-known cancer causing agent, urethane, was mixed in solution form on a trial and error basis until the trout were anesthetized to the desired degree. Recovery generally took less than 3 minutes. Chloretone was used at a dilution of 5 g/gal of water. Recovery was much faster with urethane than with chloretone. Trout recovered more quickly using MS-222 than urethane when MS-222 was used at a dilution of 1/4 gr/gal of water. A water temperature of 52° F was kept in the anesthetizing tub with the use of ice.

24 BAILEY, R. Wayne. 1972. Use of stimulants in reducing mortality in narcotized turkeys. Proc. Ann. Conf. SE Assoc. Game Fish Comm. Vol. 26, pp. 212-213.

Use of lethal dosages of tribromoethanol-treated grain in wild turkey trapping operations followed by prompt use of 2 stimulants (pure caffeine in sodium benzoate and amphetamine sulfate) and other treatment procedures improved capture success and minimized mortality.

25 BAILEY, Theodore N. 1971. Immobilization of bobcats, coyotes, and badgers with phencyclidine hydrochloride. Jour. Wildl. Manage. Vol. 35, no. 4, pp. 847-849.

Bobcats (Lynx rufus), coyotes (Canis latrans), and badgers (Taxidea taxus) were immobilized with phencyclidine hydrochloride during the initial phase of a bobcat study in southeastern Idaho. The average dosages for 39 bobcats, 8 coyotes, and 9 badgers were 1.0, 0.9, and 1.0 mg/lb, respectively. Most animals became manageable within 10 minutes and remained immobilized long enough for the collection of physical data, for tagging, and for fitting with radio transmitters. Badgers, because of their rapid defensive movements and thick, loose skin, were more difficult to immobilize than bobcats or coyotes. A dosage of 1.0 mg/lb is recommended for this species under field conditions.

26 BALL, D.J. 1974. Handling and restraint of reptiles. International Zoo Yearbook. Vol. 14, p. 133.

27 BALL, J.N., and P.N. Cowen. 1959. Urethane as a carcinogen and as an anesthetic for fishes. Nature. Vol. 184, p. 370.

The species and sometimes the strain of animal play definite roles in determining the carcinogenic properties of a substance. Urethane (ethyl carbamate) was found to induce tumors in the lungs of mice and rats, while this same compound was not carcinogenic in rabbits, chickens, and guinea pigs. Since all the potential dangers are not known about this drug, it is suggested that tricaine methanesulphonate (MS-222, Sandoz) be used as a substitute.

28 BALSER, Donald S. 1965. Tranquilizer tabs for capturing wild carnivores. Jour. Wildl. Manage. Vol. 29, no. 3, pp. 438-432.

A tranquilizer trap-tab using the drug "diazepam" has shown utility in reducing injuries to carnivores caught in steel traps and in preventing their escape. The tab consists of a cloth tablet wired to the trap jaw and contains 1 g of diazepam for coyotes (Canis latrans) and 500 mg for foxes (Vulpes sp.). Upon capture the animals usually chew the tab and ingest the drug. Ataxia follows in approximately 10-30 minutes, and struggling by the trapped animals is reduced. The effects usually last 24-48 hours, depending on the amount of diazepam consumed. This device was developed primarily for capturing animals unharmed for laboratory experiments, but it has additional applications in capturing animals for marking, in providing easy release of dogs or other pets, and in making steel trapping more humane.

29 BALSER, Donald S., and Charles Kinsey. 1962. A variable size anesthetizing chamber for animal handling. J. of Mammalogy. Vol. 43, no. 4, pp. 552-555. illus.

In order to simplify the administering of ether to animals of various sizes in the field, a variable sized airtight ether box was designed. More than 300 animals were anesthetized in this chamber. A mortality rate of less than 1% was noted. This technique was equally successful for raccoon, skunk, mink, fox, woodchuck, badger, muskrat, and Franklin ground squirrel. The procedure for transferring animals from live

trap to the anesthetizing chamber, and administering the anesthesia and handling the animals for collection of biological data are detailed step by step and a list of material required for building the chamber is given.

30 BARNHART, R.A. 1964. Effect of hepatoma on rainbow trout. Dingell-Johnson Report, Colorado, Proj.# F-024-R-02/J-01. 102 pp. (DPL-FWRS 05-6841594).

In a study on hepatoma in fish, the primary objective was to collect information and establish standards for the hematology of cultured rainbow trout. In an effort to keep the fish as quiet as possible, MS-222 was used at a concentration of 1:30,000 ppm. The lightly anesthetized fish swam slower and were less excitable.

31 BARRY, Arthur, A. 1958. Removal of scent glands in skunk. M.S.U. Vet. Vol. 19, p. 77.

Skunks have been anesthetized intraperitoneally with 1/4-1/2 cc of Nembutal using a 2 cc syringe equipped with a 25 gauge needle for the purpose of removing their scent glands.

32 BARRY, William J. 1972. Methoxyflurane; an anesthetic for field and laboratory use on squirrels. Jour. Wildl. Manage. Vol. 36, no. 3, pp. 992-993.

The inhalant methoxyflurane effectively anesthetizes gray squirrels (Sciurus carolinesis) and fox squirrels (S. niger). When administered to a restrained animal, it has a broad range of safe levels and is fast acting. Recovery is rapid and without harmful aftereffects.

33 BECK, C.C. 1972. Chemical restraint of exotic species. J. of Zoo Anim. Med. Vol. 3, no. 3, pp. 3-66.

The purpose of this paper is to provide information and guidelines on the use of the 1-arylcyclohexylamines for the chemical restraint of exotic species. Also included are some data on domestic and non-exotic species. Drug doses of phencyclidine, tiletamine, and ketamine hydrochloride are given in chart form for numerous animals from a variety of families. Some of the smaller animals listed are: minks, weasels, alligators, ferrets, martens, otters, badgers, skunks, wolverines, snakes, turtles, owls, ducks, eagles, rats, and mice. An excellent overview of information.

34 BECK, C.C. 1976. Vetalar® (ketamine hydrochloride), a unique cataleptoid anesthetic agent for multispecies usage. J. of Zoo Anim. Med. Vol. 7, no. 3, pp. 11-38.

Ketamine hydrochloride (Vetalar, CI-581), a general anesthetic, produces cataleptoid anesthesia in a wide variety of species over a wide range of dosages. The drug acts quickly with a wide margin of safety. Many charts summarizing the selected dosages and uses in zoological, wildlife and/or exotic species are included in the paper. Some of the smaller wild animals tested with the drug were: ferrets, minks, otters, skunks, raccoons, opossums, squirrels, snakes, turtles, and owls.

35 BENNETT, R.R. 1969. The use of "Metofane" in experimental laboratory birds. Practicing Vet. Vol. 40, pp. 184-186.

36 BELL, Gordon R. 1964. A guide to the properties, characteristics, and uses of some general anesthetics for fish. Fish. Res. Board Canada. Bull. no. 148, 4 pp., chart.

Information concerning the characteristics, properties, and uses of anesthetics in fish is brought together in an easy to read chart. The following trade or common name anesthetics are presented on the chart: carbon dioxide, chloral hydrate, chloretone, ether, methyl pentynol, MS-222, phenoxythanol, quinaldine, sodium amytal, tribromoethanol and tertiary-amyl alcohol. Also included is a bibliography which is intended to serve as a guide to further literature on these anesthetics.

37 BEN, Max, Robert L. Dixon, and Richard H. Adamson. 1969. Anesthesia in the rat. Fed. Proc. Vol. 28, no. 4, pp. 1522-1527.

Although this article was written with the laboratory rat in mind, some of this information may be applied to the rat found elsewhere. Various methods of restraining and anesthetizing the rat are discussed.

38 BESSER, J.F. 1973. Protecting seeded rice from blackbirds with methiocarb. International Rice Commission Newsletter. Vol. 12, no. 3, pp. 9-14.

A study was conducted at Anahuac National Wildlife Refuge, Chambers County, Texas, during April 1972 to determine the

effectiveness of the experimental bird repellent methiocarb (4-[methylthio]-3, 5-xylyl *N*-methylcarbamate) for protecting seeded rice from feeding blackbirds. Three 1-acre plots where seed was treated with 0.5% methiocarb produced about eight times more rice seedlings per acre (522,000) than three plots sown with untreated seed (66,000). Redwinged blackbirds (Agelaius phoeniceus) comprised 97.4% of the 8,902 grain feeding birds recorded in 59 observations of the six 1-acre plots, and about 13 times more redwings fed on untreated plots than treated ones. Appraisal of lower concentrations of methiocarb for this use is recommended.

39 BESSER, Jerome F., and Jack F. Welch. 1959. Chemical repellents for the control of mammal damage to plants. Trans. 24th North Am. Wildl. & Nat. Res. Conf. No. 24, pp. 166-173.

Wild animals, ranging in size from small rodents to big game, cause serious damage to silvicultural and agricultural crops. It has been found that it is often much easier to control crop damage through the use of non-toxic chemical repellents than to control the animal. Through research at the wildlife research laboratories of the Bureau of Sport Fisheries and Wildlife at Patuxent and Denver, it was found that compounds containing nitrogen, sulfur, and halides, or combinations of these elements, were the most active repellents. Three specific chemical formulations, with active ingredients, are trinitrobenzene (TNB-A), zinc dimethyl dithio carbamate cyclohexylamine complex (ZAC), and tetra methyl thiuram disulfide (TMTD). ZAC and TMTD were found to reduce damage by varying hares (Lepus washingtoni), meadow mice (Microtus montanus), and Townsend meadow mice (M. townsendii). Excellent field results were obtained protecting deciduous trees from damage by cottontails and jackrabbits with TNB-A, ZAC, and TMTD. Several other small-scaled studies of repellents on other species of wild animals, such as porcupines and beavers, are also mentioned.

40 BETZ, T.W. 1962. Surgical anesthesia in reptiles, with special reference to the water snake (Natrix rhombifera). Copeia. No. 2, pp. 284-287.

Eighteen Natrix rhombifera were injected with 30 mg/kg of Nembutal or Surital. The anesthetic administered in small aliquots induced a surgical plane of anesthesia in 40-60 minutes as evidenced by the loss of the tail-withdrawal reflex. Recovery required 18-36 hours. No form of

resuscitation was employed. Tetanic contractures, relapses, or fatalities did not occur. In two cases of over-anesthesia, 3 mg/kg of pentylenetetrazol were unsuccessfully employed as a CNS stimulant. Literature reports of the use of ether, chloroform, Nembutal, Surital, pentothal, MS-222, urethane, decamethonium iodide, and tubocurarine chloride as anesthetics in reptiles are compared.

41 BIGLER, William, and Gerald L. Hoff. 1974. Anesthesia of raccoons with ketamine hydrochloride. Jour. Wildl. Manage. Vol. 38, no. 2, pp. 364-366.

Ketamine hydrochloride, a derivative of phencyclidine, was evaluated as an intramuscular field anesthetic for raccoons (Procyon lotor) during long-term rabies virus/host studies along the Florida Gulf Coast. The optimum dosage determined for raccoons in this study was found to be 8-10 mg/kg of body weight. Two to five minutes after the drug was administered, the raccoon collapsed. All the raccoons tested had an uneventful recovery 20-50 minutes later. There was some difficulty in making complete injections of small amounts of ketamine into animals weighing less than 2,000 g.

42 BLAHM, T.H. 1961. Effect of tricaine methanesulfonate on oxygen consumption of juvenile sockeye salmon. Trans. Amer. Fish Soc. Vol. 90, no. 2, pp. 226-227.

In order to determine the feasibility of applying a constant flow respirometer to the study of fish-behavior problems, the measurement of oxygen consumption of anesthetized and nonanesthetized juvenile sockeye salmon (Oncorhynchus nerka) took place. Resulting data showed: tricaine methanesulfonate acted uniformly on fish of different sizes within this species.

43 BLASIOLA, George C., Jr. 1977. Quinaldine sulphate, a new anesthetic formulation for tropical marine fishes. J. Fish Biol. Vol. 10, no. 1, pp. 113-119.

Quinaldine sulphate is demonstrated in this study to be a convenient and safe anesthetic for use with tropical marine fishes. Both onset of anesthesia and recovery are significantly more rapid than with the parent compound, quinaldine.

44 BLEICHER, N., R.F. Sloan, J. Norfleet and F.L. Ashley. 1951. Improved anesthesia for Long-Evans rats. Proc. Animal Care Panel. Vol. 11, no. 4, pp. 245-247.

Methohexital sodium is recommended as a safe, short-acting anesthetic for Long-Evans rats. Recovery is rapid and uneventful, animals being alert and feeding 35 minutes after anesthesia. Methohexital sodium is 1-methyl-5-allyl-5-(1-methyl-2-pentyl) barbituric acid, sodium salt. It is stable in aqueous solution at room temperature (25° C) for at least 6 weeks. The pH of the solution is approximately 11.0. Compared with other ultra-short acting barbiturates, methohexital exhibits more prompt subject recovery even after large doses, probably because of a lower fat/plasma ratio of absorption.

45 BOEVER, W.J., and John Warmbrodt. 1974. Pyometera in a domestic ferret. Mod. Vet. Practice. Vol. 55, no. 9, p. 717.

A ferret, affected with pyometera and weighing 746.4 g, was anesthetized with 0.2 ml of ketamine given intramuscularly. The ferret was alert, active, and apparently normal 2 days later after its anesthesia and surgery.

46 BOEVER, William J., and William Wright. 1975. Use of ketamine for restraint and anesthesia of birds. Vet. Med./SAC. Vol. 70, no. 1, pp. 86-88.

Due to confusion in the literature concerning the proper dosage of ketamine hydrochloride for avian species, more than 50 trials on 12 different species of birds ranging in weight from 15 g to 45 kg were performed. As there are more than 850 avian species with a great amount of diversity, it was impossible, according to the authors, to suggest a safe/effective dosage range in all instances. However, base line figures for ketamine dosages were determined. In addition, lethal doses for birds in the different weight ranges are presented in table form. Ketamine was considered best in procedures requiring restraint or immobilization for short periods of time. The drug was also used as a restraining dosage in conjunction with physical restraint.

47 BOLLINGIER, R.M., J.L. Guarino, and C.P. Stone. 1974. Aerially applied methiocarb spray for protecting wild lowbush blueberries from birds. Proc. Bird Control Seminar, 1973 (Bowling Green State Univ., Ohio), Vol. 6, pp. 216-220.

An aerial application of an experimental avian repellent, methiocarb (4-[methylthio] -3, 5-xylyl *N*-methylcarbamate), at a rate of 3 pounds/acre resulted in a reduction in bird damage to wild lowbush blueberries (Vaccinium angustifolium) in New Hampshire in 1972. About 1 month after treatment, damage was 54.5% on three untreated plots, totalling about 11.5 acres, and 34.8% on three treated plots of about the same acreage. The difference in damage was significant ($P<0.005$). Robins (Turdus migratorius) and starlings (Sturnus vulgaris) were the primary species involved in the damage.

48 BORG, Karl. 1955. Chloralose and its use for catching crows, gulls, pigeons, etc. Viltrevy. Vol. 1, no. 1, pp. 85-166. (English translation available-BLM Library).

A historical perspective of chloralose is detailed giving results on the various experimentation performed. In 1949, further experiments were performed to study the effects of chloralose and its possible control of noxious birds. Cage trials were conducted on experimental birds which were given varying quantities of "alpha-chloralose puris" (free form beta-chloralose) in gelatin capsules. These birds included crows (Corvus corona cornix), magpies (Pica p. pica), pheasants (Phasianus), greylag geese (Anser s. anser), and one mountain goose (Anser crythropus). Additional trials were conducted using pure beta-chloralose on crows, pheasants, and pigeons. Field trials were also carried out using basic food of animal and vegetable origin treated with chloralose. Alpha-chloralose, as a general rule, produced sleep quickly in crows and magpies, while induction times were much longer for pigeons, pheasants, and geese. No definite relationship between induction time and content level in the crop was determined. Beta-chloralose put the birds in a state of drowsiness which was difficult to distinguish from necrosis. Lethal drug doses of chloralose were determined, and factors such as cold were tested to determine their impact on the drug's action.

49 BORZIO, Frank. 1973. Ketamine hydrochloride as an anesthetic for wildfowl. Vet. Med./SAC. Vol. 68, no. 12, pp. 1364-1367.

Ketamine hydrochloride was used to immobilize or anesthetize 22 wild birds of various species. Accurate determination of weight was found extremely important in determining drug dosages. Sleeping time was directly proportional to dosage. The initial dose recommended for most wild species is 15-20

mg/kg bodyweight supplemented with increments of 10 mg/kg. The drug was injected into the pectoral muscles and produced anesthesia in 1-5 minutes with the effect lasting 30 minutes to 6 hours depending on the dose. A table listing the birds tested, their weight, drug dosages used, effect of the drug, and other information is included.

50 BRAZENOR, C.W., and Kaye Geoffrey. 1953. Anaesthesia for reptiles. Copeia. No. 3, pp. 165-170.

Although this article describes the administration of anesthetics to certain Australian snakes and lizards, this information may be applied to anesthetizing snakes of a variety of types. Ether was used as the anesthetizing agent. The object of this study was not to arrive at the optimal anesthetic, but rather to devise a technique of obtaining casts of Australian reptiles for the National Museum of Victoria. A total of 15 snakes (11 species) were anesthetized, molded in plaster of Paris and resuscitated, with only one accidental fatality. A surgical operation was also performed on an anesthetized snake. Although lizards appeared to be more delicate than snakes and had a greater need for resuscitation, 6 lizards (5 species) were anesthetized, molded, and resuscitated without fatality. Since reptiles have no diaphragm, anesthesia in reptiles involves respiratory arrest and, therefore, a technique of artificial respiration was necessary. The snakes were placed in a glass-fronted wooden box that had a small hole in its lid but otherwise allowed little air in. Thirty ml of ether were injected into this hole by syringe onto the wooden floor. As necessary, increments of 10 ml were added to obtain the necessary anesthesia level desired. According to the species and external temperature, the snake would become torpid within a period of 20-30 minutes. Several snakes and one lizard were given relaxants successfully. It was determined that the dosage of relaxant required is up to 26 times the human dosage per kilogram. The technical problems using the drugs are discussed.

51 BREE, MAX M. 1971. Injection lesions following intramuscular administration of chlorpromazine in rabbits. J. Am. Vet. Med. Assoc. Vol. 159, no. 11, pp. 1598-1602.

The intramuscular use of chlorpromazine was evaluated in 16 New Zealand white rabbits. Four or 8 ml was injected intramuscularly in the left, or the left and right anterior or

posterior *(sic)* thigh muscles. Controls were given an equal volume of physiologic saline solution. Groups of 4 rabbits were necropsied on the 16th, 23rd, 30th, or 33rd day after injection. Local injury rather than signs of systemic illness followed injection of chlorpromazine. Clinical signs included lameness, swelling, muscular atrophy, and paralysis. Histologically, the lesions included severe myositis, coagulative necrosis, neural and perineural inflammation, vascular thrombosis, popliteal lymphadenitis, focal necrosis and gangrene of the skin, and periostitis. The signs of local injury and the histologic lesions were more extensive in rabbits injected in the posterior than in the anterior thigh muscles. Muscles of control limbs had minimal or no pathologic changes. Results indicated that intramuscular use of chlorpromazine is contraindicated for preanesthetic medication in rabbits to be used in long-term experiments.

52 BREE, Max M., and Bennett J. Cohen. 1965. Effects of urethane anesthesia on blood and blood vessels in rabbits. Lab. An. Care. Vol. 15, no. 4, pp. 254-259.

Transient abnormalities in blood and blood vessels accompanied intravenous or intracardial administration of urethane (1.5 g/kg body weight to produce effect) in 13 rabbits. Blood vessels of the ear were dilated within 2 minutes, hemorrhage occurred at the intravenous injection site in the marginal ear vein, packed cell volume fell, clotting time increased, hemolysis occurred, and serum potassium increased. Normal control values were restored within 18 hours. In addition, hemosiderin was demonstrated in sections of spleen from 6 rabbits which died within 18 hours following intraperitoneal injection of urethane (1.5 - 1.75 g/kg body weight total dose). These changes are indicative of red blood cell destruction and of damage to blood vessels. Recovery from anesthesia in the 13 rabbits was complete within 24 hours. Tissue sloughing at the venipuncture site was the only pathological lesion 3 weeks after anesthetization. Recovery from urethane anesthesia is the rule, but acute changes in blood and blood vessels accompany its use.

53 BREE, Max M., and N.B. Gross. 1969. Anesthesia of pigeons with CI-581 (ketamine) and pentobarbital. Lab. An. Care. Vol. 19, no. 4, pp. 500-502.

Ketamine, a cyclohexylamine derivative, was used in combination with pentobarbital to produce anesthesia in pigeons.

Pentobarbital sodium (20 mg/kg) was injected into the pectoral muscles in 30 pigeons. Ten minutes later, ketamine was injected into the opposite pectoral muscles in a dose of 16, 32, or 64 mg/kg in 6, 6, and 26 birds, respectively. Induction occurred smoothly but varied considerably from 5-30 minutes. Mean duration of anesthesia was 20, 40, and 109 minutes, respectively. Anesthesia was maintained during complex neurophysiological experimentation for as long as 15 hours in 12 pigeons by administering ketamine in successive doses of 32 mg/kg at 1-3 hour intervals. When recovery from anesthesia was permitted, it was uneventful.

54 BRIDGES, W.L. 1963. Fishery investigations of the Pawcatuck River drainage. Dingell-Johnson Report, Rhode Island, Proj.# F020-R-04 /J-16. 4 pp. (DPL-FWS 38-6942742).

Field work was performed on 17 streams and 7 ponds in the Pawcatuck River drainage in Rhode Island. Brook, brown, and rainbow trout numbering 11,354 were anesthetized during tagging with a 1:15,000 aqueous solution of tricaine methanesulfonate (MS-222). No problems were mentioned using this drug.

55 BRINKMAN, D.C., and G.R. Burch. 1964. Metofane® anesthesia in a variety of animal species. Allied Veter. March-April, 1964, pp. 36-43.

Metofane (methoxyflurane), a florinated ethyl methyl ether, is a safe, effective inhalent anesthesia for use in a wide variety of domestic animals, laboratory animals, and birds. Metofane is particularly useful because of its non-explosive, non-flammable properties, and its ability to produce marked muscle relaxation. Administration by endotracheal tube, nose cone, or by use of Metofane vapors in a closed unit have proved satisfactory. This anesthetic vaporizes slowly at temperatures below 79°F.

56 BRISBIN, I. Lehr, Jr. 1966. Reactions of the American alligator to several immobilizing drugs. Copeia. No. 1, pp. 129-130.

The American alligator (Alligator mississippiensis) was tested with several drugs with the hope of finding at least one drug which would give a rapid and thorough immobilization so that periodic weights and measurements might be taken. The following drugs were tested: Cap-Chur Sol (an alkaloid of

nicotine) and Cap-Chur Barb (sodium pentobarbital), both produced by Palmer Chemical Co., Douglasville, Georgia; phenylcyclidine hydrochloride; succinylcholine chloride; MS-222; and ethyl *m*-amino-benzoate. The alligators used weighed 2-5 kg, and drug dosages were determined on the basis of mg/lb body weight. The drugs were all injected intramuscularly into the base of the tail. Sodium pentobarbital gave the most satisfactory results out of the drugs tested, since it alone combined rapid action with a conveniently short recovery period. Cap-Chur Sol was unsatisfactory and not recommended for alligator immobilization.

57 BURKE, Thomas J. 1973. Reptile Anesthesia. Proc. 40th Ann. Mt. Am. An. Hospital Assoc. San Antonio, Texas; April 8-13, 1973, p. 355.

A short outlined guide on injectable anesthetics, inhalents, and hypothermia which may be used as anesthetics for reptiles. The outline includes drug dosages and length of immobilization, along with general comments about each drug.

58 CALDERWOOD, Hugh W. 1971. Anesthesia for reptiles. J. Am. Vet. Med. Assoc. Vol. 159, no. 11, pp. 1618-1625.

The purpose of this article is to discuss suitable methods of anesthesia for reptiles. Some of the methods discussed include hypothermia, anesthesia by injection, using muscle relaxants or inhalation agents, and electroanesthesia. The equipment necessary for inhalation anesthesia and the postanesthetic care required are mentioned.

59 CALHOUN, Alex. (unpub.). Hypnotic drugs as an aid in fish transportation. Calif. Dept. Fish and Game Mimeo Rept., 3 pp. Presented at 83rd Ann. Mtg. Amer. Fish. Soc., Milwaukee, Wisconsin, Sept., 1953.

This paper reports on the early uses of sodium amytal by the California Department of Fish and Game. This drug was used with a high degree of success in transporting fish to the high country lakes. The use of sodium amytal doubled the carrying capacity of the fish that could be planted.

60 CALIFORNIA Department of Fish and Game. (1973). Revised Ed. March 1979. Physical and chemical restraints of animals. 97 p.

This animal restraint handbook is designed for the California Department Fish and Game personnel involved in the drugging of wildlife. It describes chemical and physical restraint, equipment, drug pharmacology, the animals, first aid for the animal, drug dosages, and precautions. The handbook deals primarily with restraining large animals. Smaller animals mentioned include birds and beavers.

61 CAMPBELL, J.A. 1950. Use of anesthesia in treatment of zoo inmates. Canad. J. Comp. Med. Vol. 14, no. 2, pp. 39-41.

This article discusses the improvements in care, handling, and treatment of sick and injured inmates in zoological collections. The so-called "smaller" animals mentioned include swans, geese, ducks, and wading birds. The author recommends using chloroform to prevent resistance on the birds' behalf while operations are being performed.

62 CASLICK, James W. Experiments on candidate anesthetic PRC-661 (March 30-May 10, 1966). Special Report under Work Unit F-6.2, Bur. Sport Fish. & Wildl. Patuxent Wildlife Research Center, Gainesville Field Station; Gainesville, Florida. 8 pp.

Water solutions of a new drug, PRC-661, were bioassayed on red-winged blackbirds, cowbirds, starlings, grackles, and cotton rats. The redwings and cowbirds were quickly and effectively anesthetized when treated at the 10 mg/kg level. No common grackles and only one starling became completely anesthetized at 20 mg/kg and higher. Boattailed grackles died at the 60 mg/kg level, and only one of seven cotton rats were anesthetized at 60 and 120 mg/kg. Acceptance of treated bait by redwings in the field was excellent. In one field test with cracked corn treated with 2.5% PRC-661, one-half of the redwings seen feeding in the vicinity of this bait were anesthetized. Bioassay data on the stability of stored bait also are presented.

63 CASTEEL, David A., and William R. Edwards. 1965. Surgical anesthesia for cottontails. J. Wildl. Manage. Vol. 29, no. 1, pp. 196-198.

During a series of tests, it was determined that an intravenous injection of 30-50 mg/kg body weight of pentobarbital sodium into the medial auricular vein of the ear was the simplest and

safest way for inducing surgical anesthesia in cottontail rabbits (Sylvilagus floridanus), both in the laboratory and field. Pentobarbital sodium, when administered intraperitoneally, was proven to be unsatisfactory as an anesthetizing agent, but satisfactory to immobilize cottontail rabbits. Ether was found to be impractical, probably due to the lack and efficient use of apparatus equipment. A chart listing the dosage rates and results of administering pentobarbital sodium and phencyclidine hydrochloride to cottontail rabbits is included.

64 CASTILLO, Julio C., and Edwin J. de Beer. 1950. The neuromuscular blocking action of succinylcholine (diacetylcholine). J. Pharmacology & Exp. Therapeutics. Vol. 99, no. 4, pp. 458-463.

The neuromuscular blocking action of succinylcholine is described in rabbits, mice, and frogs with a comparison being made between this drug and *d*-tubocurarine chloride. A temporary paralysis of the muscles of the head, neck and extremities occurred with a single, rapid intravenous injection of 0.2 mgm/kgm of diacetylcholine in rabbits. The action of diacetylcholine was so short that it was possible to paralyze a rabbit 5 consecutive times during 1 hour without any ill effect. Diacetylcholine was found to be about one-third (1/3) as active as *d*-tubocurarine chloride in mice. Diacetylcholine did not inhibit the contraction produced by acetylcholine on the isolated gastrochemius of the frog. The neuro-muscular blocking action in the cat, rabbit, and mouse may be greatly prolonged by aserine. Decamethonium bromide (C_{10}) is also discussed and compared with the previously mentioned drugs.

65 CHANG, P.W., M.C. Perry, and V. Jasty. 1969. Fibroma in a mute swan. J. Am. Vet. Med. Assoc. Vol. 155, no. 7, p. 1039.

An adult male mute swan (Cygnus olor) suffering from a tumor on its neck underwent anesthesia to surgically remove the growth. The swan was anesthetized with 25 mg of sodium pentobarbital given intravenously. Six days after the operation, the bird was released with a healed incision.

66 CHEN, G. 1965. Evaluation of phencyclidine type cataleptic activity. Arch. Int. Pharmacodyn. Vol. 157, no. 1, pp. 193-201.

A quantitative test was performed using phencyclidine-type compounds in pigeons to assess their cataleptic activity. The cataleptic effect in pigeons is characterized by the loss of the righting reflex without "head-drop" over a wide range of dosages. Four cataleptic drugs were used in which 4 varying dose levels differing by a factor of 2 were given to 4 birds per dose. The test compound was dissolved in water to a concentration of 2 ml/kg body weight and administered intramuscularly in the leg. Through various tests, it was shown that the loss of the righting reflex without head drop was a specific test for the cataleptic action of phencyclidine type agents. When expressed in logarithms, the duration of catalepsy was linearly related to dosage.

67 CHEN, Graham, Charles R. Ensor, David Russell, and Barbara Bohner. 1959. The pharmacology of 1-1-phenylcyclohexyl) piperidine. HCl. J. Pharma. and Exp. Therapeutics Vol. 27, no. 3, pp. 241-250.

According to animal species and drug dosage, 1-(1-phenylcyclohexyl) piperidine HCl (PCP) may cause varying signs and symptoms within an animal. A variety of small animals (mice, rats, rabbits, pigeons, frogs, fish, and others) were used to investigate the neuropharmacologic effects of PCP. The drug acts primarily on the central nervous system either by stimulation or depression. When doses higher than those sufficient for general anesthesia were given, clonic convulsions occurred in pigeons, dogs, guinea pigs, and monkeys. PCP has a local anesthetic activity approximately one-half that of cocaine or twice that of procaine.

68 CHEN, Graham, and Barbara Bohner. 1968. Surgical anesthesia in the rabbit with 2-(ethylamino)-2-(2-thienyl) cyclohexanone HCl (CI-634) and chloral hydrate. Am. J. Vet. Res. Vol. 29, no. 4, pp. 869-875.

Rabbits were immobilized with a cataleptic dose of CI-634 given intramuscularly and then 2-3 minutes later were given an infusion of chloral hydrate via the marginal ear vein. The CI-634 not only produced immobilization that made intravenous injection of a large volume of solution an easy maneuver, but also enhanced the depth and duration of chloral hydrate anesthesia. With the doses of 20 mg of CI-634 per kg, the anesthesia lasted 1-1 1/2 hours. There were no marked changes in respiration or blood pressure during this period. With this drug combination, cervical ganglionectomy and oophorotomy were performed within 1 1/4 hours in rabbits under surgical anesthesia.

69 CLARK, Hugh. 1937. Embryonic series in snakes. Science. Vol. 85, no. 2215, pp. 569-570.

The desire to obtain data on Ophidian embryology led to a satisfactory method of obtaining the successive stages of development without the sacrifice of a large number of gravid females. A single female snake underwent a series of "caesarean" operations. The snake was anesthetized with Nembutal (sodium pentabarbital). A 0.5% solution of Nembutal in physiological saline solution was found the most applicable. The snake was injected intraperitoneally in the middle of the body. The exact drug dosage was found unimportant. Smaller snakes (i.e., Diadophis and Tropidoclonion) required a proportionately smaller amount of the anesthetic (0.1 cc/10 g of body weight). Approximately 100 snakes of a variety of Colubrid genera successfully underwent operations with no fatalities arising from the use of the anesthetic.

70 CLARK, William. 1977. Investigation of drug immobilization of wildlife. Wildlife investigation laboratory. Pittman-Robertson Job Progress Report, California, Proj.# W-52-R-21/J-III-1. 5 pp. (BLM Library).

Six hundred waterfowl were drugged and captured during an outbreak of duck viral enteritis (DVE) at William Land Park in Sacramento, CA. A formula was developed using 900 mg of sodium amobarbital per cup of hen scratch. Approximately 50 out of a population of 60 ducks were chemically immobilized and captured within 3 hours using 5 lb of treated grain. In the second field evaluation, 150 semi-domestic waterfowl were captured in 4 hours. In both of these tests, the duck mortality was slightly less than 5 percent. The report also includes immobilization studies that were performed on wild horses, black-tailed deer, and tule elk. Dosage rates are given, but no data tables are included.

71 CLAYTON, F.W., T.E. Bauman, and L.D. Kintner. 1966. Successful use of intrathoracic anesthesia in wild raccoons. Vet. Med./SAC. Vol. 61, no. 1, pp. 44-45.

A short acting barbiturate anesthetic, methohexital sodium, was administered to 120 wild raccoons. A 2.5% solution was injected into the thoracic cavity at the rate of 1 cc/5 lb body weight. Within 3 minutes after the drug had been given, the raccoon could be handled safely. The raccoons generally recovered from the anesthetic within 12-15 minutes. Only one

death resulted due to a rupture of the atrium resulting from cardiac puncture. In another study, using the same anesthetic, 15 captive raccoons were each anesthetized from 9-52 times or a total of 460 intrathoracic injections. Even after 10 consecutive daily injections by the intrathoracic route, the raccoons maintained a good general appearance and appetite. A discussion on handling raccoons prior to anesthesia and administering drugs intrathoracically is included.

72 CLINE, David R., Donald B. Siniff, and Albert W. Erickson. 1969. Immobilizing and collecting blood from antarctic seals. J. Wildl. Manage. Vol. 33, no. 1, pp. 138-144.

Fifty-four antarctic seals of 3 species were immobilized to obtain blood samples. Phencyclidine hydrochloride (Sernylan), in combination with promazine hydrochloride (Sparine), was injected intramuscularly using projectile syringes and an extension syringe injection device. The 3 species immobilized were the crabeater seal (Lobodon carcinophagus), Weddell seal (Leptonychotes weddelli), and elephant seal (Mirounga leonina). The crabeater seals needed a greater dosage, and there was great variation in individual responses. Complete injection is needed to prevent the drug from being injected into the fat layer resulting in slow absorption and possibly no immobilization.

73 CLINE, David, R., and Raymond J. Greenwood. 1972. Effect of certain anesthetic agents on mallard ducks. J. Am. Vet. Med. Assoc. Vol. 161, no. 6, pp. 628-632.

Seven anesthetic agents (alpha-chloralose, methoxymol, metomidate, pentobarbital sodium, secobarbital sodium, thiopental sodium, and tribromoethanol), were tested for their effectiveness in immobilizing game-farm mallard ducks (Anas platyrhynchos). The drugs were administered by proventricular intubation after food had been withheld for 16-18 hours. Out of all the drugs tested, tribromoethanol was the only compound to satisfy all the initial test criteria and was considered to have the greatest potential of the compounds evaluated. Tribromoethanol had a mean duration of induction, immobilization, and recovery periods of 2.4 minutes, 8.7 minutes, and 1.3 hours, respectively, at the median effective dosage for immobilization (ED_{50}; 100 mg/kg of body weight). The median lethal dosage (LD_{50}) was 400 mg/kg of body weight. Several undesirable qualities were noted about tribromoethanol, however, including the relatively large volume of compound necessary to constitute an effective dose in this study (100 mg/kg). Wild mallards were also

tested with tribromoethanol with somewhat less favorable results obtained. During the reproductive season, the mallards were treated with tribromoethanol to see if any ill effects would be noted on the hatchability or the survival of young. None were noted.

74 COLLINS, James L., and Andrew H. Hulsey. 1963. Hauling mortality of threadfin shad reduced with MS-222 and salt. Prog. Fish Cult. Vol. 25, no. 2, pp. 105-106.

Concentrations of salt and MS-222, alone and in combination, were studied at the Joe Hogan State Fish Hatchery in Arkansas. Longer survival of threadfin shads (Dorosoma petenese) was noticed using a 0.5 percent salt solution and a concentration of MS-222 equivalent to 1 g in 2 gal of water. Using this method, more than 200,000 threadfin shad were hauled with a survival rate consistently exceeding 95 percent.

75 CONNEL, Allan A. 1971. A new inhalation anesthesia unit for small animals. Practicing Vet. Vol. 43, no. 1, pp. 11-13, illus.

A unique unit for anesthetizing small animals weighing less than 15 pounds was developed by a practicing veterinarian. The unit effectively combines methoxflurane vapors with either oxygen, air, or a combination of both. Three standard sizes are available: 5" X 10", 6" X 20", 7" X 24"; other sizes are available upon request. Additional information on the equipment may be obtained by writing: Alcon AC/ME Co., Highway 212, Post Offic Box 23; Stillwater, Minn. 55082.

76 COOPER, J.E. 1968. The trained falcon in health and disease. J. Small Animal Pract. Vol. 9, no. 11, pp. 559-566.

In recent years, the sport of falconry has increased in popularity. A short account is given, describing the management of trained birds of prey and some of the techniques used in handling and treatment. The author of this article has found phenothiazine ineffective when given both orally and parenterally unless the drug is given in larger quantities. Larger doses often cause excitability and uncoordination. Further work on sedative drugs in birds is suggested. Various anesthetics that may successfully be used on trained hawks are mentioned.

77 COOPER, J.E. 1970. Use of the hypnotic agent "methoxymol" in birds of prey. Vet. Rec. Vol. 87, no. 24, pp. 751-752.

Methoxymol (R-7315) was used intramuscularly in 8 birds of prey of different species for techniques varying from clinical examination to surgery of wings or feet. There was only 1 mortality, a bird which was suffering from encephalitis. The remainder showed varying degrees of hypnosis and anesthesia. It is suggested that this drug may prove of value in the restraint of predatory birds for veterinary purposes.

78 COOPER, J.E. 1974. Ketamine hydrochloride as an anesthetic for East African reptiles. Vet. Rec. Vol. 95, pp. 37-41.

Ketamine hydrochloride worked extremely well as an anesthetic agent in 34 East African reptiles of 15 species. Depending on the dose, the drug produced tranquilization to deep anesthesia. Measured volumes of ketamine hydrochloride (50 mg/ml solution) were administered intramuscularly or subcutaneously to the reptiles. Extreme caution should be taken to avoid anesthetizing sick reptiles, since small doses of ketamine hydrochloride may result in fatalities. The results obtained indicate possible species or individual response to the drug.

79 COOPER, J.E. 1974. Metomidate anaesthesia of some birds of prey for laparotomy and sexing. Vet. Rec. Vol. 94, pp. 437-440.

Metomidate was used as an anesthetic for laparotomy in 9 birds of prey (Order Falconiformes and Strigiformes) of 6 species and proved to be satisfactory and safe. The anesthesia and operation are described and the value of a laparotomy in the sexing of birds of prey is discussed.

80 COOPER, J.E. 1975. First aid and veterinary treatment of wild birds. J. Small Animal Pract. Vol. 16, pp. 579-591.

Due to the large numbers of sick, injured, and orphaned wild birds, the need for better treatment and care was found necessary, especially within the veterinary profession. This literature specifically discusses the care of young birds, traumatic injuries, treatment of infectious and parasitic diseases, and birds poisoned or oiled. The main drugs used on wild birds as referred to in this paper, together with recommended drug dosages, are given in table form. In addition, some recommended anesthetics for wild birds are also included.

81 COOPER, J.E. 1978. Recent advances in the treatment of wild casualties. Bird of Prey Management Techniques. T.G. Geer, Ed. British Falconers' Club. Pp. 23-29.

Continued interest in raptor treatment and rehabilitation has improved the veterinary care available and clarified many problems previously associated with wild birds. One of the greatest advances in the care of bird casualties, according to this article, has been the development and use of safer and more effective anesthetic agents. Also, drugs such as ketamine hydrochloride and CT-1341 have been used with a high degree of success. A discussion of these advances, the history of raptor treatment/rehabilitation, and the questions still unanswered are presented.

82 COOPER, J.E., and L. Frank. 1973. Use of the steroid anesthetic CT-1341 in birds. Vet. Rec. Vol. 92, no. 18, pp. 474-479.

The use of the steroid anesthetic CT-1341 (Saffan, Glazo Laboratories, Ltd.) is described for chickens and birds of prey. Sixty chickens of varying sizes were given the drug by various routes at different dosages. Seventeen birds of prey of 15 species were injected with CT-1341 for purposes ranging from routine clinical examination to the setting of fractures and the taking of pectoral muscle biopsies. One eagle was injected with the drug 4 times within 36 hours of capture; the recovery in all 4 cases was prolonged but satisfactory. Only 1 bird of prey died, due to inadvertent inoculation into the air sac. It is concluded that the drug is of value when administered to birds by the intravenous route in order to produce short-term anesthesia. Analgesia, muscle relaxation, and speed of recovery are excellent at an intravenous dosage of up to 14 mg/kg body weight. By the intramuscular and intraperitoneal route the drug is of limited value; large volumes are necessary for analgesia. At lower dosage by such routes, the drug has a place in the immobilization of birds for non-painful procedures, but care must be taken when administering it peritoneally.

83 COOPER, J.E., and L.G. Frank. 1974. The use of the steroid anesthetic CT 1341 in birds. Raptor Research. Vol. 8, no. 1/2, pp. 20-28.

CT 1341 was used in 26 captive and recently caught birds of prey of 16 species. According to the authors, CT 1341 has a place in avian anesthesia and when used intravenously offers a

suitable alternative to metomidate. CT 1341 is an ultra-short acting agent, allowing the birds to recover rapidly. Manual restraint is necessary when administering the drug intravenously into the bronchial vein. Because the bronchial vein is easy to locate problems rarely result if a narrow gauge needle is used. When the drug is administered via the intraperitoneal or intramuscular routes, immobilization is produced, but analgesia is poor. The recommended intravenous dose is 10 mg/kg. The results are summarized in table form.

84 COOPER, J.E., and P.T. Redig. 1975. Unexpected reactions to the use of CT-1341 by red-tailed hawks. Vet. Rec. Vol. 97, p. 352.

CT-1341, a steroid anesthetic, has been found valuable and relatively safe for short-term procedures in most birds of prey. Over 50 birds of prey of several species have received the anesthetic intravenously and no fatalities occurred even in the high risk cases. However, due to a number of findings with red-tailed hawks (Buteo jamaicensis) anesthetized with CT-1341, it is suggested that special care be used with this drug. Therefore, the author recommends that small doses of 5 mg/kg or less be used in red-tailed hawks until the effects of CT-1341 in this species are confirmed.

85 COPE, Oliver, B. 1953. Chloretone as an anesthetic for adult cutthroat trout. Prog. Fish Cult. Vol. 15, no. 1, p. 35.

Adult cutthroat trout (Salmo clarkii lewisi) were successfully anesthetized using chloretone (chlorobutanol; trichloro tertiary butyl alcohol) on Yellowstone Lake during the summer of 1952. Since chloretone crystals were difficult to dissolve in cold water, it was found easier to prepare the stock solution in the laboratory prior to use. A stock solution of 10 g of chloretone crystals dissolved in 1 liter of warm water with a concentration of 1:100 was prepared. This liter of concentrate was then taken into the field and diluted until the strength was suitable for anesthetizing cutthroat in Yellowstone waters at temperatures between 35° and 55° F. By placing 12-15 adult trout at a time in a tub containing the 1:2,000 solution, the fish were anesthetized within 1-2 minutes. After the fish had been tagged, measured, weighed, and scale samples taken, the fish were placed in fresh water, recovering generally within 2-10 minutes. Comparisons between chloretone and urethane are also discussed.

86 CRASE, F.T., and R.W. DeHaven. 1976. Methiocarb: Its current status as a bird repellent. Proc. Vert. Pest Cont. Conf. Vol. 7, pp. 46-50.

Studies by the U.S. Fish and Wildlife Service of the efficacy of methiocarb for reducing bird damage to sprouting corn, rice, soybeans, lettuce, and sugar beets, and to ripening rice, grain sorghum, wheat, cherries, grapes, and blueberries have shown it to be an effective, broad-spectrum bird repellent and crop protectant. The short-term plans of the Service for the further development and testing of methiocarb are reviewed. Also discussed is some of the rationale behind the use of chemical repellents to prevent agricultural damage by birds.

87 CRAWFORD, Bruce, and Andrew Hulsey. 1963. Effects of MS-222 on the spawning of channel catfish. Prog. Fish Cult. Vol. 25, no. 4, pp. 214-215.

An experiment was set up at the State Fish Hatchery in Centerton, Arkansas, to determine the effects, if any, on anesthetizing channel catfish (Ictalurus punctatus) with tricaine methanesulfonate (MS-222). Of particular interest was to see exactly what effect this drug would have on the spawning process. The drug was used prior to spawning during the sexing and pairing operations. It was determined that this drug did not adversely affect the success of the spawn or the viability of the fry.

88 CRIBB, P.H., and J.C. Haigh. 1977. Anaesthetic for avian species. Vet. Rec. Vol. 100, pp. 472-473.

Red-tailed hawks (Buteo jamaicensis), mallards (Anas platyrhynchos) and Canada geese (Branta canadensis) were given intravenous injections of CT 1341 (Saffan; Glaxo). The authors recommended that the drug dose be kept to 5 mg/kg or less when given intravenously. A high incidence of tachycardia and sinus arrest occurred in the 3 species mentioned above with the use of CT 1341. Because of this, one should be highly cautious when using this drug.

89 CRIDER, E.D. 1967. Oral narcotic capture technique for Canada geese. Pittman-Robertson Report, Florida, Proj.# W-048-R-01/WP-01/J-A. 3 pp. (DPL-FWRS 09-6980709).

Various hypnotic and tranquilizing drugs have been tested to capture Canada geese. This report presents field data on the favorable drug combinations tried to date. The drug combinations include secobarbital and triflupromazine and secobarbital with sugar. Stelazine at 20 mg/cup of corn was also presented to free-feeding geese.

90 CRIDER, E. Dale, and Jimmie C. McDaniel. 1966. Technique for capturing Canada geese with alpha-chloralose. Proc. 20th Ann. Conf. SE Assoc. Game Fish Comm., pp. 226-233.

During the winters of 1965 and 1966, 573 Canada geese (Branta canadensis) and 5 blue geese (Chen caerulescens) were drugged with the oral anesthetic, alpha-chloralose. Whole kernel corn was coated with varying amounts of alpha-chloralose powder, and fed to the birds. In 475 geese captured with 0.25 g of drug/cup of bait, the mortality rate was 2.6%. An average capture was approximately 40 geese. A table giving the results of trials with the 6 descending amounts of alpha-chloralose to bait is listed.

91 CRIDER, E. Dale, and Jimmie C. McDaniel. 1967. Alpha-chloralose used to capture Canada geese. J. Wildl. Manage. Vol. 31, no. 2, pp. 258-264.

During field trials in the winters of 1965 and 1966, 573 Canada geese (Branta canadensis) and 5 blue geese (Chen caerulescens) were caught with alpha-chloralose, an oral hypnotic administered on bait. The mortality rate was 2.6% of 475 geese captured with 0.25 g of the drug mixed with each cup of bait. Heavier dosages produced higher mortality rates. An effective capture technique based on alpha-chloralose is described.

92 CRIDER, E. Dale, and Jimmie C. McDaniel. 1968. Oral drugs used to capture waterfowl. Proc. 22nd Ann. Conf. SE Assoc. Game & Fish Comm., pp. 156-161. (DPL-FWRS 09-7220157).

Between 1964 and 1968, diazepam, methexital, methoxymol, secobarbital, and tribromoethanol were administered on bait to free-feeding waterfowl of several species in Florida. Characteristics of each of 5 such agents include varying speed of induction, duration of anesthesia, toxicity, and other pharmacological considerations. Anesthesia was produced with several dosages of each compound, but additional tests are needed to refine dosage rates. Distasteful compounds were not readily ingested, which may have biased results in a few cases.

93 CRIDER, E. Dale, Vern D. Stotts, and Jimmie C. McDaniel. 1968. Diazepam and alpha-chloralose mixtures to capture waterfowl. Presented at 22nd Ann. Conf. SE Assoc. Game & Fish Comm., Baltimore, Maryland, October 21-23, pp. 133-141. (DPL-FWRS 09-7220156).

The use of alpha-chloralose has been found to be quite effective in capturing Canada geese (Branta canadensis) and other waterfowl species. The major drawback of the drug has been that the drug has a relatively lengthy induction period. Through a series of tests, it was determined that when alpha-chloralose was combined with diazepam, the induction time would be reduced to about one-third the time required by alpha-chloralose alone. In addition, the tranquilizer diazepam, with its rapid action, reduced the amount of alpha-chloralose necessary to immobilize most species of waterfowl. Factors affecting the dosage results included the season of the year, wintering latitudes, age, size, species, and fat deposition. Five tables are included giving data from the various tests.

94 CROFT, P.G. 1964. An introduction to the anesthesia of laboratory animals. Univ. Fed. for An. Welfare Scientific Publ. Latimer Trend & Co., Ltd. Whitstable, Great Britain. 36 pp.

The purpose of this booklet is to familiarize persons on the administration of anesthetics to small laboratory animals and/or to offer an alternate procedure from the one normally used. Procedures requiring skilled assistance or costly equipment are not described. This guide is intended to supplement practical experience. Information on equipment, handling of animals, actions and choices of drugs, administration of drugs, pre- and postoperative measures, and emergency measures are discussed.

95 CROFT, Phyllis G. 1964. Problems of anesthesia in the rabbit. In Small Animal Anesthesia, Proc. Symp. organized by British Small An. Vet. Assoc. and Univ. Fed. for An. Welfare; London, July, 1963. Oliver Graham-Jones, Ed. Macmillan Co., New York. Pp. 99-102.

The difficulties and problems of injection procedures in the rabbit during anesthesia are discussed. The methods of restraining the rabbit, determining the site of injection, choosing the correct anesthesia, and assessing the level of anesthesia necessary are included in this paper.

96 CROWLEY, G.J., and D.J. Berinati. 1972. Effect of MS-222 on blood sugar and liver glycogen in rainbow trout. Trans. Amer. Fish. Soc. Vol. 101, no. 1, pp. 125-128.

For quick anesthetization followed by immediate sampling, MS-222 does not affect carbohydrate metabolism significantly. However, anesthetization with low concentrations of MS-222 for longer terms can result in significant alterations in carbohydrate metabolism.

97 CUERRIER, Jean-Paul. 1953. Transfer of anesthetized adult lake trout by means of aircraft. Prog. Fish Cult. Vol. 15, no. 1, pp. 42-43.

The Canadian Wildlife Service, during the summer and fall of 1951, transferred 1,231 adult lake trout. Losses amounted to 10% of the fish moved. The fish were caught in nets and later placed in canvas-fiber relay tanks filled to a depth of 6 inches with an aqueous solution containing 2-5% urethane. From 20-25 fish were treated in 1 relay tank at a time with adequate anesthetization taking 4-5 minutes. After anesthesia, the fish were placed in wooden crates and covered with crushed ice. Recovery was generally from 30 minutes to somewhat less than 2 hours.

98 DAWSON, Verdel K., and Leif L. Marking. 1973. Toxicity of mixtures of quinaldine sulfate and MS-222 to fish, No. 53. In Investigations in Fish Control; U.S. Dept. of Interior, Bur. Sport Fish & Wild. Pp. 1-11.

The acute toxicities of mixtures of two fish anesthetics, quinaldine sulfate and MS-222 (tricaine methanesulfonate), to coho salmon; rainbow, brown, brook, and lake trout; carp; channel catfish; bluegill; and largemouth bass of various sizes were determined in 15-, 30-, and 60-minute, and 24-, 48-, and 96-hour static toxicity tests. The effects of various temperatures, water hardnesses, and pH's on the mixture's toxicity were evaluated. The 96-hour LD_{50}'s of $QdSO_4$: MS-222 in ratios of 1:4 ranged from 4.23 : 16.9 mg/l for lake trout to 8.63 : 34.5 mg/l for carp in standard reconstituted water at 12° C. Temperature changes had little influence on the effect of the drugs. In very soft water, solutions of the combination are acidic and considerably less toxic than in harder water. The toxicity of the mixture decreases with decreasing pH especially below pH 6.5. Safety indices (lethal concentration/effective concentration) indicate that the safety margin is greater at shorter exposures.

99 DAWSON, V.K., and P.A. Gilderhus. 1979. Ethyl-*p*-aminobenzoate (benzocaine): Efficacy as an anesthetic for five species of freshwater fish, No. 87, In Investigations in Fish Control. U.S. Dept. Interior, Bur. Sport Fish & Wildl. Pp. 1-5.

Ethyl-*p*-aminobenzoate (benzocaine) was tested for its efficacy as an anesthetic for rainbow trout (Salmo gairdneri), brown trout (Salmo trutta), northern pike (Esox lucius), carp (Cyprinus carpio), and largemouth bass (Micropterus salmoides). Since benzocaine is not water soluble, it was applied with acetone as a carrier. Concentrations of 100-200 mg/l were required for large adult northern pike, compared with 50-100 mg/l for small fish. Rates of sedation and recovery were slower in cold water than in warm water. Water hardness had little influence on the activity of benzocaine. Fish were anesthetized faster and recovered more slowly in acid than in alkaline water. Benzocaine produced deep anesthesia, but concentrations that rendered the fish handleable within 5 minutes were generally not safe for exposures longer than 15 minutes. Concentrations of benzocaine efficacious for fish were not acutely toxic to eggs of coho salmon (Oncorhyncus kisutch), chinook salmon (Oncorhyncus tshawytscha), rainbow, brown, or lake trout (Salvelinus namaycush). Benzocaine is not registered for fishery use and is neither more effective nor safer than the registered anesthetic, tricaine methanesulfonate (MS-222).

100 DELIUS, Juan D. 1966. Pentobarbital anesthesia in the herring and lesser black-backed gull. J. Small Animal Pract. Vol. 7, pp. 605-609.

A procedure for long lasting general anesthesia in gulls (Larus sp.) is described. It is based on an initial basal intramuscular dose of pentobarbital sodium, supplemented if necessary by intravenous injection of the same agent until the desired effect is reached. Additional intramuscular pentobarbital is used to extend the duration of anesthesia. The labile respiration of the birds is supported with oxygen. In cases of respiratory failure, intravenous methetharimide is an effective reactivator. A survival rate of better than 95% has been achieved with this method in gulls undergoing neurosurgery for 2-3 hours.

101 DENNETT, D. 1965. Effects of administration of tranquilizers. Pittman-Robertson Job Completion Report, Louisiana, Proj.# W-029-R-12/ WP-09/J-05. 10 pp. (DPL-FWRS 17-6983119).

The oral tranquilizer Tranimul has successfully been used in capturing and handling various species of wildlife. Additional testing is suggested in administering this tranquilizer to birds. All the animals received the tranquilizing agent by oral administration and dosage rates varied according to the species being trapped, trapping localities, and the territory of the bait material. The animals specifically tested included 128 deer, 2 black bears, Canada geese, and 2 turkeys. Rabbits were easily captured at baiting locations established for these other species.

102 DENNETT, D. 1966. Tranquilizer confinement of birds. Pittman-Robertson Job Completion Report, Louisiana, Proj.# W-029-R-13/WP-09/J-12. 14 pp. (DPL-FWRS 17-6983144).

The effects of the oral tranquilizer Tranimul on penned game birds have been studied. Wild bobwhite quail, game farm bobwhite quail, wild black francolin, and game farm black francolin were used as test birds for this study. Several methods of administration were tested and evaluated. Desirable dosage rates were selected by observing the reactions of penned game farm bobwhite quail to measured amounts of Tranimul offered to them in commercial game bird laying rations. Six pens of each species were used in this study. Pens containing quail were stocked at the rate of 1 male and 2 female birds per pen. Pens containing black francolin were stocked with 1 male and 1 female per pen. Each of the different kinds of test birds used in this study was divided into 3 groups of 2 pens each. One group received a heavy dosage of Tranimul, 1 group received a light dosage of Tranimul, and 1 group was used as a control. Egg production, egg fertility, and egg hatchability for each group were measured. Data obtained during this study suggested that in egg production there was more variation between individual pens than there was between treatment levels of the drug. Tranimul also had no apparent effect on egg fertility or hatchability.

103 DENNETT, D. 1967. Tranquilizer confinement of birds. Pittman-Robertson Job Completion Report, Louisiana, Proj.# W-029-R-14/WP-09/J-12. 9 pp. (DPL-FWRS 17-6983173).

The effects of the oral tranquilizer Tranimul on penned bobwhite quail (Colinus virginianus) have been studied. A new drug method of administration was tested and adopted. Dosage rate used was determined during earlier investigations with the drug. Tranimul was mixed with a commercial game bird

laying ration and offered free choice to the test birds. Twenty-one pairs of wild-trapped bobwhite quail were used as test animals in this study. Each pen was stocked with 1 male and 1 female bird. Eleven pens were fed calibrated dosages of Tranimul and 10 pens were kept as controls. Egg production and egg fertility for each group were measured. Data obtained suggested that egg production was not influenced by the administration of the drug Tranimul.

104 DENNETT, D., and R.E. Murry. 1962. Effects of oral administration of tranquilizers on various species. Pittman-Robertson Report, Louisiana, Proj.# W-029-R-09/WP-09/J-5. 7 pp. (DPL-FWRS 17-6983066).

Nutria, deer, grey foxes, and turkeys were all administered Tranimul in varying quantities. After administration of Tranimul, grey fox and some deer received Librium. The methods employed, drug dosages used, and recommendations are included within the paper.

105 DEROCHE, S.E. 1960. Comparison of Lake trout populations in two Maine lakes. Dingell-Johnson Report, Maine, Proj.# F-013-R-05. 45 pp. (DPL-FWRS 18-6741280).

The Maine Fishery Research and Management Division was involved in several studies to learn more on the life history of the lake trout (Salvelinus namaycush). After netting numbers of lake trout, a need to anesthetize these fish became apparent in order to facilitate handling and tagging. The trout were first anesthetized with urethane (17 g/1 gal of water) and later, MS-222 was used at a concentration of 0.33 g/gal of water. The paper includes information on spawning, age and growth, creel census, mortality rates, population estimates, and possible management implication of the lake trout.

106 DICK, Gillian L. Some observations on the use of MS-222 (Sandoz) with grey mullet (Mugil chelo Cuvier). J. Fish Biol. Vol. 7, no. 1, pp. 263-268.

Two trials, each using grey mullet, were carried out to investigate the use of the anesthetic, MS-222 (tricaine methanesulfonate), in the handling and transportation of fish. The first trial examined the effect of using various concentrations of MS-222 and it was concluded that concentrations between 1:75,000 and 1:100,000 were sufficient to tranquilize the fish

for pre-transport handling. A further trial using the anesthetic at a concentration of 1:110,000 and with a fish biomass of 50 g/liter demonstrated that tranquillized fish could safely be held at this density for a 48-hour period. It was concluded that the use of an anesthetic such as MS-222 could aid handling and loading operations and induce quiescence for a transportation period of up to 48 hours in duration.

107 DILBONE, R.P. 1965. Thiamylal anesthesia in a penguin. J. Am. Vet. Assoc. Vol. 147, p. 1076.

A 2.5 solution of thiamylal sodium was used to anesthetize a 12 lb Humboldt penguin in order to remove an epithelial-like growth. The drug was administered intravenously into well-outlined veins on the posteromedial aspect of the bird's flippers. The initial injection was 1 cc (25 mg) followed by two additions amounting to 1.25 cc. The penguin was anesthetized for approximately 12 minutes and was alert and standing within 20 minutes.

108 DOLOWY, William C. 1960. Chlorpromazine premedication with pentobarbital anesthesia in a mouse. Am. J. Vet. Res. Vol. 21, pp. 156-157.

Pentobarbital sodium given alone results in unsatisfactory anesthesia for major surgery in mice because of the great variation in response of individuals. Improved results reported with chlorpromazine hydrochloride as a preanesthetic in dogs, cats, rabbits, and rats led to investigation of its effects in mice.

109 DOLOWY, Wm. C., and A.L. Hesse. 1959. Chlorpromazine premedication with pentobarbital anesthesia in the rabbit. J. Am. Vet. Med. Assoc. Vol. 134, no. 4, pp. 183-184.

Pentobarbital sodium given alone results in unsatisfactory anesthesia for surgery in rabbits because of the great variation in response of individual rabbits and the short duration of surgical anesthesia. In this particular experiment, chlorpromazine hydrochloride was given intramuscularly as a preanesthetic in doses ranging from 25-100 mg/kg of body weight. After this initial dose, 20 mg/kg of pentobarbital sodium was given intravenously resulting in easier handling of the animal. New Zealand white rabbits were used in this experiment.

110 DONOVAN, B.T. 1964. Anesthesia of the ferret. In Small Animal Anesthesia, Vet. Assoc. & Univ. Fed. Animal Welfare; London, July, 1963. Oliver Graham-Johns, Ed., The Macmillan Co. New York. Pp. 185-186.

Pentobarbitone sodium administered intraperitoneally is extremely effective in anesthetizing ferrets. For major surgical tasks, a dose of 36 mg/kg of pentobarbitone sodium (0.60 ml/kg Nembutal, Abbott) given in a single injection intraperitoneally is usually sufficient. Within 2 minutes visible effects of the drug are seen, and within 5 minutes the animal is asleep. Unfortunately, the period of anesthesia is extremely variable, and the animal usually has a slow recovery. Food is not recommended to be given before anesthetization. Deaths are rare with careful administration of the drug into healthy animals.

111 DOREMUS, Henry M. 1965. Heart rate, temperature and respiration rate of short-tailed shrew in captivity. J. of Mammalogy Vol. 46, no. 3, pp. 424-425.

The heart rate, respiration rate and body temperature of the short-tailed shrew (Blarina brevicauda) were recorded from a colony of 52 shrews captured alive in the vicinity of Stowe, Vermont, and maintained in the laboratory. The mean heart rate of 20 shrews under pentobarbital sodium anesthesia was 760 beats/min, and for 10 shrews under ether anesthesia it was 740 beats/min. Pentobarbital sodium was injected intramuscularly at a rate of 1.2 mg/20 g body weight; complete anesthesia occurred in 5 min lasting 30 minutes.

112 DUDLEY, William R., Lawrence R. Soma, Catherine Barnes, Theodore C. Smith, and Byran E. Marshall. 1975. Lab. An. Science. Vol. 25, no. 4, pp. 481-482.

A simple apparatus was designed for simultaneous general anesthesia of a number of small laboratory animals with spontaneous respiration. Anesthesia is consistent over many hours. The apparatus consists of an oxygen tank and vaporizer, a glass distribution bottle, and a non-return circuit of separate inspiratory and expiratory valves for each animal. The equipment is inexpensive to construct and can be rapidly adjusted for exact control of gas flow and anesthetic depth.

113 EISLER, Ronald, and Tadeuz Backiel. 1960. Narcotization of chinook salmon fingerlings with tricaine methanesulfonate (MS-222). Trans. Amer. Fish. Soc. Vol. 89, no. 2, pp. 164-167.

Chinook salmon fingerlings were exposed to varying concentrations of tricaine methanesulfonate (MS-222) for a period of 5 minutes. Groups exposed to concentrations of 1:10,000 and greater experienced heavy mortality. Concentrations of 1:50,000 and less proved ineffective for narcotizing purposes. Experimental evidence indicates that the lowest concentration of the drug capable of narcotizing the test animals within the alloted time period is 1:33,000. Fingerlings can withstand this dose (1:33,000) for at least 105 minutes without ill effects, but an immersion approaching 241 minutes is fatal. Fingerlings adapted to either a salt-water environment of 52° F or to a fresh-water environment of 59° F were narcotized with equal facility. During a 2-week observation period following recovery, no latent effects of narcotization were noted in any test animal.

114 ENDO, Toshio, Kenji Ogishima, Hisashi Tanaka, and Satoshi Ohshima. 1972. Studies on the anesthetic effect of eugenol in some fresh water fishes. Bull. Jap. Soc. Sci. Fish., Vol. 38, no. 7, pp. 761-767. (In Japanese with English abs.).

Eugenol (4-allyl-2-methoxyphenol) was found to exhibit an anesthetic effect on various fishes. Carp (Cyprinus carpio), Medaka (Oryzias latipes), crucian carp (Carassius auratus), and rainbow trout (Salmo gairdnerii irideus) were anesthetized in a short time in water containing 12.5-100 ppm of eugenol as added to water in the form of FA-100 (a pharmaceutical preparation of 10% eugenol). Eugenol was effective at only one-fourth the concentration of MS-222 that would give comparable effects in gold fish (Carassius auratas), medaka, and crucian carp. Anesthesia by FA-100 and recovery from it required longer time at low water temperatures (5° and 10° C) than at normal temperature (24.5° C).

115 ESCHMEYER, Paul H. 1953. The effect of ether anesthesia on fin-clipping rate. Prog. Fish Cult. Vol. 15, no. 2, pp. 80-82.

The U.S. Fish and Wildlife Service Station located at Charlevoix, Michigan, marked 141,392 fingerlings as part of an experimental program to learn the effects of stocking lake trout (Salvelinus namaycush) in Lake Superior. A total of

27,832 fish were clipped using ether and 24,729 fish were clipped without anesthesia. Within 2 weeks after marking, there was a mortality of 0.22% and 0.15%, respectively. A 1% aqueous solution of ether was used to quiet the fish anesthetized. A satisfactory level of anesthesia resulted at this concentration with a prevailing water temperature of 56° F. As required, additional ether could be added; the concentration of ether ranged between 0.5% and 1.5%.

116 EVANS, Ronnie R., John W. Goertz, and Clifford T. Williams. 1975. Capturing wild turkeys with tribromoethanol. J. Wildl. Manage. Vol. 39, no. 3, pp. 630-634.

Wild turkeys (Meleagris gallopavo) were captured with tribromoethanol, an oral-basal anesthetic. The bait used in all testing was wheat. The bait was presoaked one or two hours so that the drug would adhere to its surface. Due to the swelling of the wheat when soaked, more drug could adhere to the larger surface area. Because of having additional drug on the bait, this improved the reaction time of the turkeys to the drug. Dosage levels ranged from 2.3/40 g (=2.3 g of drug/40 g of bait) to 3.5/50 g. Turkeys were captured with all levels tested, with 2.4/40 g giving the best results. Those birds fed at the 2.4/40 g level had a rapid recovery and were all alert within three hours after consuming the bait. Bait with a higher concentration of the drug (2.5/50 g) required a much longer time of recovery. Lower dosage levels (2.0/50 g, 2.3/40 g) caused light narcosis and capture was difficult. Handling of turkeys is also discussed.

117 EVEREST, F.H. 1978. Diver-operated device for immobilizing fish with a small explosive charge. Prog. Fish Cult. Vol. 40, no. 3, pp. 121-122, illus.

While conducting studies on behavioral ecology of juvenile salmonids at the Idaho Cooperative Fishery Research Unit in northern Idaho, a diver-operated device was developed for collecting individual fish. Specimens less than 30 cm long can easily be collected by this device which detonates an electric blasting cap. Fish smaller than 5 cm long can be stunned in a stream if the cap is detonated within about 0.5 m of the specimen. The device contains a fiberglass probe attached to a pistol-shaped Plexiglas handle containing a 9 volt battery to power the electric circuit. The probe may be altered in length (1-3 m) for varying environmental conditions and for compact storage. According to the author,

the device has proven to be effective and reliable during several years of use and the collection of hundreds of fish. The device may be limited to certain ecological and physiological conditions. Detailed drawings, along with a photograph of the device, are included.

118 FEDDE, M.R. 1978. Drugs used for avian anesthesia: A review. Poultry Sci. Vol. 57, no. 5, pp. 1376-1399.

The most common drugs used to tranquilize birds for both experimental and veterinary purposes are presented in this paper in table form. The table provides a few details on each of the drugs, recommendations and comments about its use, reported dosages, and the original source of the information. A variety of birds are mentioned. An excellent, easy-to-read review.

119 FELDMAN, Donald B., and James L. Self. 1971. Sedation and anesthesia of the Virginia opossum, Didelphis virginiana. Lab. An. Science. Vol. 21. no. 5, pp. 717-720.

Five drugs were individually tested and evaluated in 50 wild-captive opossums. The results of the 4 drugs administered intramuscularly showed that both fentanyl-droperidol (0.75-1.0 cc/kg) and ketamine hydrochloride (20-25 mg/kg) showed good immobilization properties. Phencyclidine hydrochloride gave poor muscle relaxation and had a very narrow margin of safety. Promazine hydrochloride was found unsuitable and ineffective even when the drug was used in large quantities. The inhalant agent, methoxyflurane, easily induced and maintained anesthesia for prolonged periods of time.

120 FEURT, S.D., J.H. Jenkins, F.A. Hayes, H.A. Crockford. 1958. Pharmacology and toxicology of nicotine with special reference to species variation. Science. Vol. 127, no. 3305, pp. 1054-1055.

Depending on the species of animal, nicotine will have varying effects on the susceptibility to the animal. This article discusses this aspect of nicotine along with the various dosage levels that can be administered by intramuscular injection to 14 species of animals. Small animals mentioned include: pigeons, mice, rats, rabbits, guinea pigs, chinchillas, dogs, and cats. A chart lists the minimal effective dose (mg/kg) and the therapeutic index for nicotine.

121 FIELD, E.J. 1957. Anesthesia in rabbits. J. Animal Tech. Assoc. Vol. 8, no. 2, pp. 47-48.

Nembutal was administered in 350 recovery operations with no supplementary inhalation anesthetics given. Urethane was used in nearly 200 non-recovery operations and was considered the most suitable. However, the animals recovered slowly from urethane, often not being restored to normal even after 36 hours. For this reason, urethane is not recommended for relatively short procedures in which an anesthetic is required. Methods, drug dosages, and difficulties that may be encountered are also discussed in this account.

122 FISH, Frederic F. 1943. The anesthesia of fish by high carbon dioxide concentrations. Trans. Amer. Fish Soc. Vol. 72, pp. 25-29.

A practical and economical method for anesthetizing adult salmon and steelhead trout in the fish trucks used in the Grand Coulee fish salvage program is described. The method involves generating a predetermined carbon dioxide concentration in the 1,000 gallon tanks of the trucks through the successive addition of predissolved sodium bicarbonate and dilute sulphuric acid in proper quantities. Carbon dioxide anesthesia effectively solved the acute problem of species segregation in the fish salvage program and, with minor modifications, could be used with equal success in certain hatchery operations necessitating the handling of large fish.

123 FITZGERALD, James P. 1973. Four immobilizing agents used on badgers under field conditions. J. Wildl. Manage. Vol. 37, no. 3, pp. 418-421.

Badgers (Taxidea taxus) were successfully immobilized using 4 different drugs under field conditions in central Colorado during an ecological investigation of an enzootic plague (Yersinia pertis) focus. A total of 33 individual doses of the drugs were administered to captured animals. Six badgers were immobilized using phencyclidine hydrochloride, acepromazine maleate was used on five, chlorpromazine hydrochloride was used on five, and succinylcholine chloride was used on 17 badgers. All of the drugs were successful in immobilizing the badgers, but succinylcholine chloride proved most useful in the present study, because the animals recovered quickly from its effects. Dosages of phencyclidine hydrochloride and succinylcholine chloride were respectively higher and lower than those reported by other workers using these drugs on badgers.

124 FLYGER, Vagn. 1961. Handling wild mammals with a new tranquilizer. Trans. 26th North Am. Wildl. & Natl. Res. Conf. No. 26, pp. 230-233.

Chlordiazepoxide, when administered to wild animals in proper dosages, has been very successful in making these animals easy to handle. The drug can be administered parenterally or orally in capsule form. Through a series of studies, it has been determined that when chlordiazepoxide is given at the rate of 30-40 mg/kg body weight, the animal becomes docile enough to handle barehanded. Dosage levels exceeding 40 mg/kg body weight produce ataxia. The animal remains docile 24-36 hours after the drug has been given, while larger dosages cause the animal to have effects which last for four or five days. Generally speaking, there is less contrasting response noted in mild-mannered animals than in aggressive or vicious animals. A chart giving the results of intraperitoneal injection of chlordiazepoxide in raccoons (Procyon lotor), New York weasel (Mustela frenata), skunk (Mephitis mephitis), gray fox (Urocyon cinereoargenteus), feral domestic cat (Felis domestica), woodchuck (Marmota monax), gray squirrel (Sciurus carolinensis), white-footed mouse (Peromyscus leucopus), porcupine (Erethizon dorsatum), cottontail (Sylvilagus floridanus), and varying hare (Lepus americanus) are given.

125 FLYGER, Vagn, Murray S.R. Smith, Robert Damm, and Richard S. Peterson. 1965. Effects of three immobilizing drugs on Weddell seals. J. Mammology. Vol. 46, no. 2, pp. 345-347.

The 3 drugs used were nicotine alkaloid, phencyclidine hydrochloride, and succinylcholine chloride. The drugs were hand injected into the gluteal region of sleeping seals (Leptonychotes weddelli). Nicotine produced convulsions when given in sufficient immobilizing dosage (1.7-3.9 mg/kg). Phencyclidine caused mild convulsions in some seals, effects lasted up to 24 hours, and effective dosage was 0.5 mg/kg. Succinylcholine was the fastest acting of the drugs, but effects lasted the shortest time also. Effective dosage was 2.8 mg/kg. Nicotine was determined to be least satisfactory due to convulsions. The other 2 drugs are suitable depending on the needs of the investigator. However, none of the drugs are suitable for remote injection of seals lying close to the water, as escape will be made before the drug takes effect.

126 FOLEY, Diane M., James E. Stewart, and R.A. Holley. 1966. Isobutyl alcohol and methyl pentynol as general anesthetics for the lobster, Homarus americanus Milne Edwards. Canadian J. Zool. Vol. 44, pp. 141-143.

In trying to locate a proper drug to anesthetize the mature lobster (Homarus americanus Milne Edwards), tricaine methanesulfonate (MS-222, Sandoz), quinaldine, ether, chloroform, and magnesium sulfate were tried. These drugs proved unsuitable due to large dose requirements that were not practical or because all doses were ineffective. Two other agents, isobutyl alcohol and methyl pentynol, were tried. Both of these drugs were effective, although the data obtained from the various experiments indicated that isobutyl alcohol was a better material for anesthetizing lobsters. The merits of isobutyl alcohol include: toxic effects are not evident, even at high concentrations; smaller doses work well; and the relationship between concentration and effect is good. Drug dosages, recovery times, and procedures for anesthetizing the lobsters are included in this paper.

127 FOSTER, Richard F. 1941. Marking trout under anesthesia. Prog. Fish Cult. No. 54, pp. 30-31.

During population and migration studies on young black-spotted trout (Salmo clarkii lewisi) in Yellowstone National Park, it became desirable to mark the fish with a higher degree of speed and accuracy. A 5% solution of C.P. ether was used initially and, as this solution became progressively weaker with continued use and evaporation, the solution was strenthened with the addition of the 5% stock solution. Figures obtained show that all of the larger trout and approximately 96% of the smaller fish recovered from the anesthesia.

128 FOWLER, Murray E. 1978. "Restraint." In Zoo and Wild Animal Medicine. Murray E. Fowler, Ed., W.B. Saunders Co., Philadelphia. Pp. 35-52.

Chapter 6 in this book discusses physical and chemical restraint of animals. Basic information on how to handle animals, what equipment is necessary, and considerations for immobilizing animals are discussed.

129 FOWLER, Murray E. 1978. Restraint and handling of wild and domestic animals. Iowa State University Press, Ames. 332 pp., illus.

This excellent book discusses and illustrates the principles of animal restraint and handling. Restraint practices for diverse species of vertebrate wild and domestic animals are also mentioned.

130 FRANK, L.G., and J.E. Cooper. 1974. Further notes on the use of CT 1341 in birds of prey. Raptor Research. Vol. 8, no. 1/2, pp. 29-32.

The steroid anesthetic, CT 1341, was further tested on 7 North American raptors to determine its effect on the cardiac system. Several reports of a possible, but unproven nature indicated that cats given this drug showed adverse cardiac effects. Therefore, the bird's heart rate was monitored by stethoscope, and respiration was counted visually. The results showed that abnormal cardiac rhythms existed in 6 of the 7 birds. Usually by the time the bird showed response to stimulation, normal rhythm was restored. The results of this testing are given in outlined form. Until the endocrinological effects of CT 1341 are known, it is suggested that care be taken in administering it to breeding raptors as the main component of CT 1341, alphaxalone, has a superficial resemblance to progesterone.

131 FREDRICKSON, L.F., and C.G. Trautman. 1974. Use of stupefacient and tranquilizer drugs for capturing and handling pheasants, 1967-1973. Pittman-Robertson Report. South Dakota, Proj.# W-075-R-16/WP-10P/J-01/FIN. 36 pp. (DPL-FWRS 40-7780145).

Five oral anesthetics were tested on penned pheasants to evaluate their usefulness for pheasant capturing and transportation purposes. Satisfactory results were obtained only with tribromoethanol (Avertin) when using 18 g/lb of shelled corn. Time required for effective narcosis was 40 minutes. Recovery among 75% of the birds occurred within 16 hours. It is recommended that Avertin be used in the field at this dosage. The catch rate compared with that from other trapping methods.

132 FREDRICKSON, Larry F., and Carl G. Trautman. 1978. Use of drugs for capturing and handling pheasants. J. Wildl. Manage. Vol. 42, no. 3, pp. 690-693.

Five orally administered anesthetics (tribromethanol, Tranimul, methoxymol, metomidate, and sodium pentobarbital) were tested on penned pheasants (Phasianus colchicus) to

determine their suitability for pheasant capture and transportation when corn was used as the bait. Tribromethanol showed the most promise of those drugs tested for capturing wild pheasants and tranquilizing penned pheasants for transport purposes. Pheasants may be captured only once using this drug. Prebaiting winter flocks of game birds should take place for 1-2 weeks previous to setting out drugged corn (57-85 g). For recovery purposes, birds should be kept at room temperature during the winter months in order to prevent hypothermia. A review of previous experimentation on various drugs is described along with the reasons why the other drugs were found unsuitable.

133 FRIDDLE, S.B., and S.F. Snieszko. 1950. Effect of Tricaine methanesulfonate on the determination of sulfonamides. Science. Vol. 112, no. 2902, pp. 181-182.

In tests performed to determine the concentrations of sulfamerazine in the tissues of fingerling trout (Salvelinus fontinalis), tricaine methanesulfonate (MS-222) was used as an anesthetic. Because the results obtained were inconsistent with other results, tests were carried out to determine the effect, if any, of the anesthetic on the sulfonamide test. The fish were anesthetized for less than 1 minute when dipped in a solution of MS-222 1:5,000 in spring water. It was shown that MS-222 or other anesthetics with similar molecular structure interfere with the calorimetric tests for sulfonamides.

134 FRIEND, M. 1962. Investigations of reservoirs of wildlife diseases transmissable to man and animals. Pittman-Robertson Report. New York. Proj.# W-035-R16/WP-04/J-C. 25 pp. (DPL-FWRS 31-7080537).

The purpose of this investigational project was to determine the occurrence and prevalence of pathogenic organisms in wildlife species in the state of New York. During the course of this study, muskrats that were trapped at Montezuma National Wildlife Refuge were given Nembutal intraperitoneally in solution form. A drug dosage level of 1/8 grain/lb of body weight was administered, and anesthesia was produced in muskrats within 15 minutes.

135 FROMM, Paul O. 1958. A method for measuring the oxygen consumption of fish. Prog. Fish Cult. Vol. 20, no. 3, pp. 137-139.

During a study to measure oxygen consumption, experimental fish were anesthetized with a 0.03% solution of tricaine methanesulfonate (MS-222) before being placed in a respirometer. By immersing the fish into MS-222 for 30-45 seconds, measurements of length and weight were easily made. Fish normally recovered in 10 minutes, or less. No lasting effects were noted in the general metabolic rate with the use of MS-222.

136 FROMM, Paul O., Brent D. Richards, and Robert C. Hunter. 1971. Effects of some insecticides and MS-222 on isolated-perfused gills of trout. Prog. Fish Cult. Vol. 33, no. 3, pp. 138-140.

Gills were isolated from hatchery rainbow trout (Salmo gairdneri) and later exposed to several chemical compounds including MS-222, a general anesthetic used in fish. MS-222 was found to have an acute effect on isolated gills, resulting in a reduced flow of perfusion fluid through them. The paper includes two tables of data obtained during the experimentation.

137 FRY, F.E.J., and K.S. Norris. 1962. The transportation of live fish. In Fish as Food, Vol. II. George Borstrom, Ed. Academic Press. N.Y. Pp. 595-608.

The conclusions drawn by other authors on the following subjects are briefly summarized: (1) use of anesthetics to reduce the metabolic rate of fish in transport; (2) the type of drug(s) to select for use; and (3) concentrations of drugs. The concentrations in g/US gal for California killifish and the opaleye as determined by McFarland (1960) are reported. The remainder of the paper describes a variety of factors involved in the transportation of live fish.

138 FRYE, Frederic F. 1972. Surgical removal of a cystic calculus from a desert tortoise. J. Am. Vet. Med. Assoc. Vol. 161, no. 6, pp. 600-602.

A large, adult male tortoise (Gopherus agassizzi) suffering from a cystic calculus underwent surgery to remove this mass. Anesthesia was induced through an anesthesia adapter using a 4% halothane-oxygen mixture. After the reptile was thoroughly anesthetized, a noncuffed endotracheal catheter (3 mm O.D.) was inserted into the trachea. A closed-circuit gas anesthesia machine with a 0.5 liter breathing bag was utilized. A 2% mixture of halothane and oxygen was used to maintain surgical anesthesia.

139 FRYE, Frederic L. 1973. "Surgery and Pathology". In Husbandry Medicine and Surgery in Captive Reptiles. VM Publishing, Inc. Bonner Springs, Kansas. Pp. 112-135.

The local anesthetic, lidocaine, has been used in a number of alligators during digital amputations, and in one instance the drug was used to amputate the left rear leg of an American alligator. Lidocaine worked well during these amputations, although it was hard to maintain total restraint of the 360 lb animal having its leg amputated. General anesthetic agents, both gaseous and injectable, have been found safe and effective. Smaller reptiles respond well when given 20-40 mg/kg of ketamine hydrochloride intramuscularly. Generally, ketamine hydrochloride allows 30-60 minutes of chemical restraint at room temperature. M-99 is also discussed and is highly recommended by the author for use in alligators and caimans. Equipment that may be used for anesthesia is briefly mentioned. The majority of the chapter deals with surgery and pathology.

140 FUHRMAN, Frederick, and Ernst T. Stuhr. 1941. Pentobarbital sodium as an anesthetic for minks. J. Am. Vet. Med. Assoc. Vol. 98, no. 766, pp. 43-44.

Intravenous administration of barbiturates to minks was found impractical. Pentobarbital sodium, administered subcutaneously, produced hypnosis satisfactory for examination of the animals, and suitable for artificial insemination studies. The minimum hypnotic dose administered subcutaneously as a 2% solution was determined as 22 mg/kg body weight. There was no correlation between sex and dose.

141 FULLER, Mark R., Patrick T. Redig, and Gary E. Duke. 1974. Raptor rehabilitation and conservation in Minnesota. Raptor Research. Vol. 8, no. 1/2, pp. 11-19.

Treatments requiring anesthesia relied almost entirely on ketamine given at a rate of 20-40 mg/lb (44-88 mg/kg). In most cases, this included sufficient anesthetization for completion of most procedures. If longer procedures were necessary, the raptor could be intubated and put on metofane or halothane and/or nitrous oxide anesthesia. Acepromazine in combination with ketamine reduced the amount of ketamine used by approximately 30%. In addition, this drug combination produced a smoother recovery. This drug method was only tested on a broadwinged and 2 red-tailed hawks. A considerable variation in dose/response with ketamine was noted.

142 GALVIN, Chuck. 1976. Avian drugs and dosages. Handout for: Wildlife Rehabilitation Council; P.O. Box 3007; Walnut Creek, CA 94598.

The purpose of this handout is to provide information on a wide variety of drugs and dosages that have been used on birds. Three local anesthetics are mentioned, in addition to 3 analgesics and 16 anesthetics/tranquilizers. The material is compiled from a variety of sources.

143 GANDAL, Charles P. 1956. Satisfactory general anesthesia in birds. J. Am. Vet. Med. Assoc. Vol. 128, pp. 332-334.

Safe, satisfactory surgical anesthesia was induced in a variety of birds, from common crows to peacocks, in 122 clinical and experimental trials. The drug Equi-Thesin was used at a dosage rate of 2.5 cc/kg body weight. Two tables are included showing the results of the trials.

144 GANDAL, C.P. 1958. A practical method of obtaining blood from anesthetized turtles by means of a cardiac puncture. Zoologica. Vol. 43, pt. 3, pp. 93-94.

The Animal Hospital of the New York Zoological Park developed a successful technique of cardiac puncture. Using this technique, a 6% solution of pentobarbital sodium is used to anesthetize the turtles given at the rate of 0.1 grain/240 g of body weight. The various turtles used with this method include the box turtle (Terrapene c. carolina) and the red-earred turtle (Pseudemys scripta elegans). This method is believed applicable in other species.

145 GANDAL, Charles P. 1962. Avian general anesthesia. International Zoo Year Book. Vol. 4, pp. 141-142.

After anesthetizing over 800 birds of various types, the author of this article recommends the following procedures: Equi-Thesin given intramuscularly at a rate of 2.5 cc/kg body weight constitutes a safe and satisfactory general anesthetic. Dosage rates are adjusted accordingly for birds that are not in good physical condition, and in poorer risks, the dosage may be decreased to 2.0 cc/kg. More predictable results may be obtained using the median vein in larger species (pigeon size and larger) for intravenous injections of the drug. It is extremely important that the

birds be weighed accurately, especially the smaller birds, as the margin of safety is approximately 30% and decreases substantially with inaccurate weight estimation.

146 GANDAL, C.P. 1968. A practical anesthetic technique in snakes, utilizing methoxyflurane. Animal Hospital. Vol. 4, no. 4, pp. 258-260, illus.

Reptiles of a wide variety of species were successfully anesthetized at the Bronx Zoo in New York with methoxyflurane. The use of the drug may be adapted for short or lengthy procedures by using various techniques. One of the methods described was placing the snake in an airtight transport container and injecting a measured amount of the drug into the chamber. If longer anesthesia was required, the snake was hooked up to an anesthetic machine. No fatalities occurred using this system of operation.

147 GANDAL, Charles P. 1969. Avian anesthesia. Fed. Proc. Vol. 28, no. 4, pp. 1533-1534.

Equi-Thesin is the drug of choice for overall safety and efficiency in anesthetizing birds by this author. No adverse gross tissue reactions were noted in over 700 birds of various species that have been anesthetized intramuscularly with Equi-Thesin. For healthy, normal birds, a drug dose of 215 ml/kg is recommended, while 2.0 ml/kg body weight is suggested for poor-risk, weak, or debilitated birds. Other information on this drug, as well as inhalation and local anesthetics, are discussed in this paper. The article also mentions what to do in case of respiratory or circulatory failure in birds.

148 GANDAL, Charles P. 1969. "Surgical techniques and anesthesia." In Diseases of Cage and Aviary Birds. Margaret L. Petrak, Ed. Pp. 217-231.

Chapter 11 in this book gives a helpful overview on performing safe and satisfactory anesthesia in birds. General and local anesthesia, along with the various anesthetic agents available, are discussed in some detail. The problems often associated with using general anesthetic in birds and how to combat overdosage of drugs are described. Equi-Thesin (Jensen-Salsbery Laboratories) is recommended and is considered the drug choice for most procedures. The chapter also gives information on surgical techniques for birds.

149 GARDNER, A.F. The development of general anesthesia in the albino rabbit for surgical procedures. Abs. 15th Ann. Mtg. Animal Care Panel; Sept. 21-25, 1964, New York Hilton Hotel, New York. In Lab. An. Care. Vol. 14, no. 4, pp. 327-328.

Sixty-one domesticated albino rabbits were administered three agents which are members of the barbiturate family and combinations of preanesthetic agents to determine a satisfactory reproducible general anesthesia for surgical procedures. One of the distinquishing features of this investigation is a clinical evaluation of the usefulness of surital sodium to produce surgical anesthesia in the rabbit. In this study an attempt was made to provide a general picture of an anesthetic that is satisfactory for surgical procedures on the rabbit. This study indicates that the preanesthetic agents administered were of little value.

150 GATES, Wm. H. 1932. The use of "Nembutal" as an anesthetic for mice. Science. Vol. 76, no. 1972, pp. 349-350.

Sodium ethyl (1 methyl butyl) barbituate (Nembutal) was found quite satisfactory as an anesthetic in mice. The drug was administered by injecting a fine hypodermic syringe into the peritoneal cavity. According to the author, sodium ethyl barbiturate has many advantages over ether or other gaseous anesthetics. The drug may be repeatedly given. Single doses, large enough to anesthetize for three to four hours, seldom resulted in death. No adverse aftereffects were noted from the use of the drug. The recommended solutions were 1 grain Nembutal dissolved in 5 cc or 10 cc of water. Complete anesthesia within the mouse was produced in 3-5 minutes, depending on the amount of drug given. A table giving the dosage, average time to anesthetize, and average recovery time is included.

151 GEBHARDS, Stacy. 1965. Transport of juvenile trout in sealed containers. Prog. Fish Cult. Vol. 27, no. 1, pp. 31-36.

In order to develop an efficient method of transporting trout in a lightweight container, a variety of tests were conducted during 1962 and 1963. Studies in Idaho on juvenile salmonids showed no increase in loading density or reduction in mortality during transport with the use of MS-222 (tricaine methanesulfonate).

152 GERKING, Shelby D. 1949. Urethane (ethyl carbamate) in some fishery procedures. Prog. Fish Cult. Vol. 11, no. 1, pp. 73-74.

The now known cancer producing agent, urethane (ethyl carbamate), is described in this article as having a non-toxic property. The chemical agent is highly recommended for allowing quicker operations (i.e., weighing, measuring, tagging, or marking) on the fish to take place without their undue alarm. An experiment was performed on redfin shiners (Notropis umbratilis), small common suckers (Catostomus commersonii), and rainbow darters (Poecilichthys caeruleus) using 0.5%, 1.0%, and 1.5% urethane by weight. The 0.5% solution was found adequate as this concentration acted quickly, and the fish could remain in this solution for at least 18 minutes.

153 GIBSON, R.N. 1967. The use of the anesthetic quinaldine in fish ecology. J. An. Ecology. Vol. 36, pp. 295-301.

The properties of the anesthetic quinaldine were investigated in order to assess its suitability for capturing fish from rock pools. The minimum exposure times for complete anesthesia at concentrations of 20, 10, 5, and 2.5 ppm were determined for five species of littoral fish. The required time for anesthesia varies from 0.75-2.7 minutes at 20 ppm, to 3.2-9.0 minutes at 5.0 ppm. It was found that a concentration of 2.5 ppm was insufficient to induce the required depth of anesthesia in all the species tested. Long exposures (2 and 5 hours) cause some mortality in Acanthocottus bubalis and Pholis gunnelus at 20 and 15 ppm. Recovery is rapid after anesthesia, varying from 2-25 minutes, depending on the concentration and the species. The recovery time after long exposures is slightly greater. The influence of quinaldine on behavior is briefly described. Its mode of action is considered to be analogous to that of barbiturates. Quinaldine was tested on the shore at concentration of 5-10 ppm and found to facilitate the capture of fish from rock pools. It is suggested that this drug could be of great value in obtaining fish from such habitats for short- or long-term ecological studies.

154 GILBERT, Perry W., and F.G. Wood, Jr. 1957. Method of anesthetizing large sharks and rays safely and rapidly. Science. Vol. 126, pp. 212-213.

In order to determine the effects of the anterior pituitary on mating behavior and reproduction in elasmobranchs, it became necessary to handle rays and sharks of substantial size. After testing a variety of tranquilizers and anesthetics, the narcotic MS-222 was shown the most useful. A concentration of 1/1,000 (1 g of MS-222 in 1 liter of seawater) was used. Smaller fish received 100 ml, while the larger fish received up to 1 liter of this solution. With the use of a water pick, rubber ball syringe, or hand sprayer, this solution was introduced easily into the gills by way of the mouth of a shark or the spiracles of the ray. The recovery was gradual and complete.

155 GILDERHUS, Philip A., Bernard L. Berger, Joe B. Sills, and Paul D. Harman. 1973. The efficacy of quinaldine sulfate as an anesthetic for freshwater fish, No. 49. In Investigations in Fish Control. U.S. Dept. of Interior, Bur. of Sport & Wildl. 9 pp.

Quinaldine sulfate ($QdSO_4$), an improved formulation of the fish anesthetic quinaldine, was tested for its efficacy on 15 species of freshwater fish. The new crystalline formulation is water soluble and thus easier to use than practical grade quinaldine. $QdSO_4$ anesthetizes most salmonids at 25 mg/liter in less than 4 minutes, and the fish recover in 1-13 minutes in freshwater. The effective concentrations for several warmwater species varied from 15 mg/liter for bluegills to 60 mg/liter for channel catfish. Fish were held for up to 60 minutes in effective concentration without suffering mortalities. The efficacy of the anesthetic was little affected by water temperature, but the compound lowers the pH of some soft waters to below 6, the point at which it becomes ineffective as an anesthetic. All fish retained some reflex action so some large fish were difficult to handle.

156 GILDERHUS, Philip A., Bernard L. Berger, Joe B. Sills, and Paul D. Harman. 1973. The efficacy of quinaldine sulfate: MS-222 mixtures for the anesthetization of freshwater fish, No. 54. In Investigations in Fish Control. U.S. Dept. of Interior, Bur. Sport Fish. & Wildl., Pp. 1-9.

Combination of quinaldine sulfate ($QdSO_4$) and MS-222 were tested for their efficacy in anesthetizing 14 species of freshwater fish. The combinations induced rapid and deep anesthesia, as does MS-222, and permitted long, safe holding

times, as does $QdSO_4$. The concentrations of the combined anesthetics needed were considerably lower than those needed when MS-222 is used alone. Most salmonids tested required concentrations of 10:20 to 10:40 mg/liter ($QdSO_4$:MS-222) for effective anesthetization. Warmwater species generally required higher concentrations of 10:40 to 20:75 mg/liter. Large adult fish usually required higher concentrations than smaller fish. Both compounds lower the pH of the solution; and at pH's approaching 6.0 or below, the combinations were much less effective. In soft waters where the pH was lowered to that point, buffering the pH back to 6.5 or higher restored the activity of the anesthetics.

157 GILES, Robert H., Jr., Ed. 1969. Wildl. Manage. Techniques. The Wildlife Society, Inc. Washington, D.C. 623 pp.

Information on anesthetizing animals is found in Wildlife Management Techniques on the following pages:

P. 298. A short discussion on the use of tribromoethanol as an aid to catching wild birds alive. Included is a step-by-step method on administering the drug successfully.

Pp. 300-307. The terminology used when working with drugs is briefly defined. Information on the use of various drugs on reptiles, birds and mammals is reviewed. Three tables are listed giving the species of animal, the dosage of drug given, how the drug was given, the amount of drug used, and other pertinent information.

158 GLENN, James L., R. Straight, and C.C. Snyder. 1972. Clinical use of ketamine hydrochloride as an anesthetic agent for snakes. Am. J. Vet. Res. Vol. 33, no. 9, pp. 1901-1903.

Ketamine hydrochloride was found excellent as a tranquilizer and anesthetic agent for venomous snakes weighing 6.8 kg or less. The drug was injected intramuscularly and produced a tranquil or a deep state depending on the dose used (22-132 mg/kg). The authors recommend that endotracheal tubes and oxygen support systems be made available when using dose levels larger than 110 mg/kg.

159 GLENN, J., R. Straight, and C.C. Snyder. 1972. Ketalar-A new anaesthetic for use in snakes. International Zoo Year Book. Vol. 12, pp. 224-226.

Ketalar (ketamine hydrochloride) has been found excellent in anesthetizing snakes. The drug dose level can be accurately controlled, enabling short or long duration procedures to take place. Probably the best method for administering ketalar to snakes is through intramuscular injection at one or more sites dorsally along the spine and preferably along the tail area. When 2 ml or more of ketalar (50 mg/cc) is required, injection of the dose should occur at two or more sites on larger snakes. Specific doses of 10-30 mg/lb are required for larger snakes. The LD_{50} was computed as 70 mg/lb. The anesthesia remained in effect 5-7 days in snakes that survived larger doses (60 mg/lb). Smaller snakes receiving doses of 50 mg/lb or less were tranquil for at least 48-96 hours. No aftereffects have been observed in snakes drugged with ketalar. The authors recommend that intraperitoneal administration of the drug should be investigated.

160 GOSSINGTON, Robert. 1957. An aid to fish handling - tricaine. Aquarium J. Vol. 28, no. 9, pp. 318-321.

This article reports on the uses of the drug MS-222. The drug simplifies handling fish for examination, experimentation, stripping, marking, treatment of a localized disease, or for any reason that the subject needs to be quiet.

161 GRAHAM, David L., and Robert H. Dunlop. 1967. Barbiturate anesthesia in ranch mink. Am. J. Vet. Res. Vol. 28, no. 122, pp. 293-296.

Two anesthetic agents, pentobarbital sodium and thiamylal sodium, were selected to determine their efficacy and possible toxicity to 160 ranch mink (Mustela vison). Also investigated in 30 animals was the use of the analeptic bemegride to reduce the recovery time from pentobarbital narcosis. The intramuscular route of administering thiamylal sodium was unsuccessful and considered an unsuitable anesthetic procedure in mink. A dose of 40 mg/kg of pentobarbital sodium induced light anesthesia in 88% and deep anesthesia in 75% of the mink with no mortalities. Anesthesia lasted an average of 37 minutes. The post-anesthetic and ataxia period was considerably reduced using bemegride at a dose rate of 40 mg/kg. No deaths resulted using bemegride, however, a potential danger exists due to toxic responses with this drug.

162 GRAHAM-JONES, Oliver. 1964. Restraint and anesthesia of some captive wild mammals. Vet. Rec. Vol. 76, no. 44, pp. 1216-1243, illus.

This is probably one of the more complete articles discussing restraint and anesthesia in captive wild mammals. The paper is broken down into 3 basic groupings of animals: small (up to 2.5 kg), medium (2-20 kg), and large (25 kg and above). The various types of manual restraints, which include nets, anesthetic boxes, and trap boxes for the smaller sized animals, are described and pictured. Methods of restraint and anesthetic boxes which are commonly used for the medium and large animals are also shown and explained. The paper also includes information on: the use of ataractic drugs as aids to restraint of captive or feral wild animals, administration of drugs, a description of the drugs and their disadvantages for use, and the choice of anesthetic to use.

163 GRAHAM-JONES, Oliver. 1965. Restraint and anesthesia of small cage birds. J. Small Animal Pract. Vol. 6, pp. 31-39.

Some aspects of the restraint and anesthesia of birds, including small birds such as the budgerigar, are described together with some of the volatile, gaseous, and non-volatile drugs available. Methods of induction of anesthesia and sites of injection are discussed.

164 GRAHAM-JONES, O. 1966. The clinical approach to tumors in cage birds. III. Restraint and anesthesia of small cage birds. J. Small Animal Pract. Vol. 7, pp. 231-239.

Some aspects of the restraint and anesthesia of birds, including small birds, are described together with some volatile, gaseous, and non-volatile anesthetic drugs. Methods of induction of anesthesia and sites of injection are discussed.

165 GREEN, C.J. 1975. Neuroleptanalgesic drug combinations in the anesthetic management of small laboratory animals. Lab. Animals. Vol. 9, pp. 161-178.

Trials of different drug combinations for use in rabbits, guinea pigs, rats, hamsters, and mice are described in detail, and experience over a 5-year period is evaluated.

Combinations of fentanyl citrate, fluanisone, and diazepam provided exceptionally good anesthesia in each species and were considered superior to other injectable agents.

166 GREEN, C.J. 1978. Anaesthetising ferrets. Vet. Rec. Vol. 102, no. 12, p. 269.

In a letter to the editor, this author reports on anesthetizing ferrets in the laboratory. The family Mustelidae have been found to be good subjects for anesthesia. Ferrets respond quite similarly to cats to most injectable drugs. Unlike cats, however, ferrets do not exhibit adverse responses to morphine-like drugs. Recommended drugs for chemical restraint before standard inhalation include the following: alphaxolone-alphadolone, ketamine hydrochloride, and fentanyl citrate-fluanisone. These same drugs may be used to provide light surgical levels of anesthesia. Drug dosages for each of these agents are provided. The barbiturate, pentobarbitone sodium, may be given if the other drugs are unavailable. However, this drug requires a long recovery period and the animal may exhibit muscular twitching, shivering, and limb paddling movements.

167 GREEN, C.J. 1979. Animal anaesthesia; Laboratory Animal Handbooks, Vol. 8. Biochemical Society Book Depot, Commerce Way, Colchester, England CO2 8HP, UK, 300 pp.

The subject of this handbook is the anesthesia of vertebrates; including wild, zoo, companion, and farm species; but with special attention to problems encountered in laboratory animal work. There are 6 chapters that treat the vertebrates systematically: Amphibia, reptilia and aves; Lagomorpha, rodentia, insectivora and chiroptera; Ungulata; Carnivora; Primates, marsupialia, edentata, tubulidentata; and Aquatic animals. In each of these the literature and existing practice are reviewed, and relevant physiological data tabulated. From this the author goes on to formulate detailed recommendations for the anesthesia of each species, together with its preanesthetic and post-operative management. A background is provided for the systematic chapters by 9 others: General principles; Physiological considerations; Pharmacology of drugs acting on the CNS; Preanesthetic medication and chemical restraint; Local and regional analgesia; Muscle relaxants; General and balanced anesthesia; Anesthetic management; Euthanasia.

168 GREEN C.J., and S. Precious. 1978. Reptilian anesthesia. Vet. Rec. Vol. 102, no. 5, pp. 110.

This letter to the editor suggests that tricaine methanesulfonate be used as an alternative to ketamine hydrochloride. Tricaine methanesulfonate was used in several nonvenomous species of snakes producing rapid onset of activity, a relatively quick recovery, and excellent muscular relaxation. It is suggested that this drug be further assessed in other reptiles.

169 GREEN, C.J., J.E. Copper, and D.M. Jones. 1977. Cryotherapy in the reptile. Vet. Rec. Vol. 101, p. 529.

Cryotherapy was tried on an adult Indian rock python (Python molurus) suffering from stomatitis and an extensive ulcerating granuloma. The python weighing 14.5 kg was administered 50 mg/kg of ketamine hydrochloride intramuscularly. Thirty minutes later, the snake, now sedated, was easily handled. The snake made an excellent recovery.

170 GREEN, C.J., M.J. Halsey, S. Precious, and B. Wardley-Smith. 1978. Alphaxolone-alphadolone anesthesia in laboratory animals. Lab. Animals. Vol. 12, pp. 85-89.

The anesthetic steroid combination alphaxolone-alphadolone is a well-established, short-acting, injectable agent for cats and primates. It can be recommended for intravenous administration to rats, rabbits, neonatal pigs, mice, and hamsters. It has limited value in mice and hamsters by the intraperitoneal route but provides sedation in ferrets and neonatal pigs when injected intramuscularly. It can be given repeatedly or continuously to maintain anesthesia for long periods without the development of tolerance or cumulation.

171 GREGG, D.A., and L.D. Olson. 1975. The use of ketamine hydrochloride as an anesthetic for raccoons. J. Wildl. Disease. Vol. 11, no. 3, pp. 335-337.

Ketamine hydrochloride was observed to be an effective anesthetic for recently captured raccoons (Procyon lotor) when injected intramuscularly with 20-29 mg/kg body weight. Excellent anesthesia occurred from 5-15 minutes after injection. No respiratory difficulties were encountered. The only undesirable clinical sign was excessive salivation.

172 GRIFFITH, John Q., Jr. 1949. "General methods." In Rat in laboratory investigation. E.J. Farris and J.Q. Griffith, Jr., Eds. J.B. Lippincott Co., Philadelphia. Pp. 19-23, illus.

Methods of handling, restraining, and anesthetizing the rat are described. Ether is the preferred anesthesia for all operative procedures of short duration in which a mask may be employed. The anesthetic Nembutal (Abbott Laboratories) works well for prolonged procedures. Anesthesia by freezing is discussed for young rats. Other drugs tested include chloroform and evipal sodium.

173 GRIFFITHS, Francis P., Glaucus Webb, and Phillip W. Schneider. 1941. Ether anesthesia of steelhead trout. Am. Fish. Soc. Trans. Vol. 70, pp. 272-274.

The use of anesthetics offers numerous advantages when handling, marking, or spawning fish which are susceptible to fungus diseases and injuries. Small trout were weighed and measured easily while anesthetized. Steelhead trout, under anesthesia, were very easy to spawn artificially. The loss from eggs so obtained was less than the average hatchery losses of eggs for the species. A 1% aqueous solution of ether anesthetized trout effectively in 45-90 seconds, and these fish remained relaxed when placed in fresh water for 3-20 minutes.

174 GUARINO, Joseph L. 1972. Methiocarb, a chemical bird repellent: A review of its effectiveness on crops. Proc., 5th Vertebrate Pest Control Conf. Fresno, California, March 7-9, 1972.

Since 1964 when the effectiveness of methiocarb for preventing pheasants (Phasianus colchicus) from damaging sprouting corn was proven in South Dakota, an aggressive program has been carried out by personnel of the Denver Wildlife Research Center and many cooperators to develop methiocarb as a broad spectrum avian repellent. The successful use of methiocarb for preventing damage caused by several species of birds to sprouting corn in several states and to sprouting soybeans in South America is reviewed. Recent results obtained from spraying methiocarb on ripening rice in California, ripening sorghum in Colorado and Oklahoma, cherries in Michigan, and grapes in New Hampshire are summarized.

175 GUARINO, Joseph L., and James E. Forbes. 1970. Preventing bird damage to sprouting corn with a carbamate repellent. New York Fish and Game Jour. Vol. 17, no. 2, pp. 117-120.

The effectiveness of DRC-736 [4-(methylthio) -3, 5-xylyl *N*-methyl-carbamate] as a seed treatment to reduce bird damage to sprouting corn was evaluated in April 1969, at the Three Rivers Wildlife Management Area in New York. One method of calculation showed that approximately 83% fewer plants were destroyed by birds in treated fields, while a second method showed a damage reduction of about 71%.

176 GUARINO, J.L., W.F. Shake, and E.W. Schafer, Jr. 1974. Reducing bird damage to ripening cherries with methiocarb. J. Wildl. Manage. Vol. 38, no. 2, pp. 338-342.

An experimental repellent, methiocarb [4-(methylthio) -3, 5-xylyl *N*-methylcarbamate], was evaluated as a 0.16% spray treatment for reducing bird damage to ripening cherries in a sweet cherry (Prunus avium) orchard and a tart cherry (P. mahaleb) orchard in Michigan in 1971. Bird damage to untreated fruit was high (at harvest, over 45% in sweet cherries and over 50% in tart cherries). Robins (Turdus migratorius) and common grackles (Quiscalus quiscula) caused most of the damage to the sweet cherries; starlings (Sturnus vulgaris), to the tart cherries. In both orchards, bird damage at 6 days after methiocarb treatment was significantly less in treated than in untreated trees. At harvest (2 weeks after treatment), damage in treated trees was reduced 65.6% in the sweet cherry orchard and 62.2% in the tart cherry orchard; this reduction was highly significant ($P<0.005$).

177 GUARINO, J.L., C.P. Stone, and W.F. Shake. 1974. A low-level treatment of the avian repellent, methiocarb, on ripening sweet cherries. Proc., Bird Control Seminar, 1973 (Bowling Green State University, Ohio). Vol. 6, pp. 24-27.

A test was conducted on a row of 19 sweet cherry trees (Prunus avium) in Michigan in 1972 to determine the effectiveness of a low-level spray treatment of an experimental avian repellent, methiocarb [4-(methylthio) -3, 5-xylyl *N*-methylcarbamate], for reducing bird damage to cherries. Results showed that the treatment rate (0.33 lb active material/100 gal water) was too low for protecting cherries against a variety of avian species. Although difference in damage between treated trees (31.6%) and untreated trees (54.9%) were significant ($P<0.005$), the damage level in the former is probably unacceptable to growers.

178 HACKENBROCK, Charles R., and Mieczyslaw Finster. 1963. Fluothane: A rapid and safe inhalation anesthetic for poisonous snakes. Copeia. No. 2, p. 440.

Rapid yet safe anesthesia was desired to anesthetize poisonous snakes. This paper discusses this objective with the use of Fluothane (halothane), a volatile liquid. The method employed to anesthetize these snakes was so simple that one person could perform the necessary procedures. The amount of Fluothane needed depends on the size of the snake and on the volume of the container in which the snake was anesthetized. No specimens were lost due to an overdose. Fluothane vapor used on the poisonous snakes was found extremely useful in milking the venom glands, force-feeding, weighing, marking, sex determination, administration of medication, diagnosis of tumors/cysts, etc. Fluothane may also work as a preliminary anesthetic before using a longer lasting agent such as Nembutal. A review of some of the previous literature on this subject is included.

179 HAGEN, E. Odette, and J. Martin Hagen. 1964. A method of inhalation anesthesia for laboratory mice. Lab. An. Care. Vol. 14, no. 1, pp. 13-15, illus.

Trichlorethylene, halothane and methoxyflurane were used to try to induce surgical anesthesia in mice. The first two were not suitable, but the third gave excellent results. After induction in a glass jar, anesthesia was maintained using piped air as the vehicle for the volatile non-explosive anesthetic.

180 HAIGH, J.C., Hazards to humans from immobilizing drugs. Dept. Vet. Clinical Studies; West. College Vet. Med.; Univ. Saskatchewan, Saskatoon, Saskatchewan.

This article discusses the potential hazards to humans from immobilizing drugs. Neuromuscular blocking agents and centrally acting compounds are discussed. It is advised that in a case of accidental poisoning, medical help be sought as quickly as possible. All persons working with immobilization drugs should be briefed and given basic instruction before an emergency arises. In case an emergency does arise, the vial(s) of the offending drug should accompany the patient. The minimum requirements for a first aid kit are given in table form.

181 HAIGH, J.C., 1976. The use of CT 1341 for surgical anaesthesia in a pelican. J. of Zoo Anim. Med. Vol. 7, p. 39.

A white pelican (Pelicanus onocrotalus) was severely injured and required medical attention. The bird was anesthetized with the steroid anesthetic CT 1341 (Saffan). This drug has 12 mg of total steroid per ml; 9 mg alphaxolone and 3 mg alphadolone acetate. The bird which weighed 5.5 kg was given a total drug dose of 5.5 ml. Initially, a dose of 2.5 ml was administered at the rate of 5.45 mg per kg. A deep anesthesia was produced, with the pelican showing no response to painful pressure on the interdigital web of the foot or interphalangeal joints. Nine minutes after the last injection of CT 1341, the bird was standing up alert.

182 HAIGH, J.C., 1978. Use and abuse of drugs for chemical restraint of wildlife. Vet. Clinics N.A. Vol. 8, no. 2, pp. 343-352.

The drugs most commonly used for immobilizing animals are discussed along with the advantages, disadvantages, availability, and effects as reported by others. The drugs primarily discussed are the neuromuscular blocking agents, succinylcholine chloride and nicotine sulfate; and the psychotropic drugs, barbiturates, etorphine hydrochloride, fentanyl, phencyclidine hydrochloride, ketamine hydrochloride, and xylazine. The neuromuscular blocking drugs are summed as being inhumane, inefficient, unnecessary, out-of-date, and associated with high mortality. The conclusion made on the psychotropic drugs is that when used with sufficient care they can provide controllable, predictable results with little or no undesirable side effects. Their high cost should not deter a person from using them.

183 HAIGH, J.C., H.C. Rowsell, and T.I. Hughes. 1978. Preliminary results of immobilizing wild untrapped seals with a narcotic. Presented at 9th Ann. Conf. & Workshop of Internatl. Assoc. Aquatic An. Med.

Twelve wild grey seals were injected on Sable Island, Nova Scotia, with the narcotic drug fentanyl citrate using the Zoolu .22 blank Powder Projector and the Dist-inject air rifle. Seven of these were actually immobilized. There were 3 mortalities, 2 due to overdose and 1 due to lung damage from the needle. Induction times varied from 2.5 to 15 minutes, and in 3 cases a net was used to prevent a seal from entering the water during the induction period. The antagonist used was naloxone hydrochloride.

184 HAKANSSON, C.H., and B. Malcus. 1969. A reflex-controlled automatic anesthesia device for animal use. Phys. Med. Biol. Vol. 14, no. 4, pp. 559-562.

A method is described for the achievement of steady-state anesthesia of small animals by the servo-controlled injection of anesthetic agents, using the integrated electromyograph as the feedback signal. The use of this method for anesthesia in the herring gull (Larus argentatus) is also described.

185 HANSON, W.D., 1970. Acclimatization and utilization of threadfin shad. Dingell-Johnson Report, Missouri, Proj. # F-001-F-19/WP-05/J-02. 26 pp. (DPL-FWRS 24-7240323).

Research on Missouri Reservoirs showed that an additional species was necessary to supplement the gizzard shad, the main forage base. The threadfin shad (Dorosoma petenense) was selected as it is a very close relative to the gizzard shad. The threadfin shad were hauled from their habitat in water which contained 0.5 percent by weight of common salt and 0.08 g/gal of MS-222. Later it was determined that only salt was really required in hauling these fish short distances.

186 HARCOURT-BROWN, N.H., and F.M. Harcourt-Brown. 1978. Anaesthetising ferrets. Vet. Rec.. Vol. 102, no. 12, p. 269.

This letter to the editor reports that 15 ferrets were anesthetized very satisfactorily with Fluothane and oxygen administered on a McGill circuit with a Hall's mask. The ferrets recovered rapidly and no short or long-term problems were noted due to the use of the anesthetic.

187 HARDING, K.A. 1977. The use of ketamine anaesthesia to milk two tropical rattlesnakes (Crotalus durissus terrificus). Vet. Rec. Vol. 100, pp. 289-290.

A series of 5 experimental milkings using ketamine as the anesthetic are described. The drug produced effects which, depending upon the dose, ranged from tranquilization to deep anesthesia. No apparent side effects were observed. It is concluded that anesthesia could play an important role in the safe milking of venomous snakes.

188 HARRISON, Greg J., and Murray E. Fowler. 1978. "Rabbits, hares and pikas (Lagomorpha)." In Zoo and Wild Animal Medicine. Murray E. Fowler, Ed. W.B. Saunders Co. Philadelphia. Pp. 479-490.

Chemical restraint agents vary greatly in their effects on rabbits. The most suitable method thus found has been using acepromazine maleate, followed 5-10 minutes later by ketamine hydrochloride and xylazine hydrochloride. Using the drug dosages recommended, anesthesia should last 30-45 minutes. As necessary, additional doses of ketamine hydrochloride may be given. Ketamine hydrochloride used alone will not provide suitable analgesia, even with doses of 50 mg/kg.

189 HARTHOORN, A.M. 1976. The chemical capture of animals. Bailliere Tindall, London. 416 pp., illus.

A complete guide on the mechanics of capturing and immobilizing animals. Included are methods of capture, injection, emergency treatment, some physiological anatomy, and the various drugs available. The book primarily deals with large wild animals; however, the use of a variety of drugs is discussed in the following classes which include many small animals: Aves, Amphibia, Reptilia, and Osteichthyes.

190 HARTNETT, John C. 1954. A convenient method for anesthetizing the frog. Turtox News. Vol. 32, no. 3, p. 67.

A rapid and easy method for anesthetizing a large number of frogs at one time is described in this short paper. By immersing a frog in 0.2% trichloro-tertiary-butyl alcohol (chloretone) for 4-8 minutes, satisfactory relaxation resulted allowing for capillary observation. After the initial immersion, the frog recovered 3-6 hours later. Complete and normal behavior was observed in less than 24 hours after anesthetization.

191 HAUPERT, John, and Michael Lindeen. 1974. The use of ketamine hydrochloride in wild birds, mammals, and reptiles. Iowa State Univ. Vet. Vol. 36, no. 1, pp. 21-22.

A discussion on the use of ketamine hydrochloride, its effects on animals, and drug dose guidelines are presented within this paper. Forty-two raccoons (Procyon locor), varying in age, were given 1.5 mg/lb to 12 mg/lb of ketamine hydrochloride. Best results were obtained using 10-12 mg/lb; however, at this drug dosage, the recovery period extended for

6-8 hours. Good restraint was achieved at 8.5 mg/lb and the animals recovered in 2-6 hours. Also safely anesthetized with the drug were 12 skunks (Mephitis mephitis) and 4 opossums (Didelphis virginianis) using 8 mg/lb. Most doses were administered intraperitoneally, although this technique is not recommended for caged animals due to the possibility of a puncture in the abdominal viscera. One golden eagle, 1 pigeon, and 1 red-tailed hawk were successfully induced using 20 mg/kg. The birds received half the dose in the right pectoral and the other half in the left pectoral.

192 HEALEY, E.G.. 1964. "Anesthesia of fishes" in Small Animal Anesthesia, Proc. Symp. organized by British Small An. Vet. Assoc. & Univs. Fed. for An. Welfare; London, July, 1963; Oliver Graham-Jones, Ed., The Macmillan Co., New York. Pp. 59-70, illus.

This literature describes the various methods for immobilizing or anesthetizing fish. Urethane and tricaine methanesulfonate (MS-222) are reviewed and the physiological effects of anesthetics upon the fish are described. In addition, the article includes information on anesthesia during surgical operations and the possible harmful effects of anesthetics on man. The equipment necessary for surgical operations is discussed and illustrated.

193 HEALEY, P. 1967. A simple method for anesthetizing and handling small carnivores. J. Inst. Animal Tech. Vol. 18, no. 1, pp. 37-38.

Due to the difficulty and hazard in handling the stoat (Mustela erminea), and weasel (Mustela nivalis), a suitable method was required to restrain these animals. The method devised incorporated a volatile anesthetic, halothane, and a wooden box in which the animal was trapped. Once the box was occupied, a piece of absorbent cotton wool was wetted with 1 ml of halothane and placed into the box. Normally in 30-60 sec after insertion of the halothane soaked cotton wool, the animal may be removed, with anesthesia lasting for about 2 minutes. If longer anesthesia was desired, face mask techniques were used. This method has proved to be simple, inexpensive, and reliable.

194 HEUSCHELE, Werner. 1960. Castration of a squirrel. Mod. Vet. Practice. Vol. 41, p. 59.

It is recommended by this writer that ether, by inhalation, be used while a squirrel is being castrated.

195 HEUSCHELE, Werner P. 1961. Immobilization of captive wild animals. Vet. Med. Vol. 56, pp. 348-351.

Five sea lions (Zalophus californianus) and many other species of large wild animals were given succinylcholine chloride to produce immobilization through temporary muscle paralysis. The drug was administered intraperitoneally with the use of the projectile syringe. Two of the five sea lions died due to an obvious overdose of the drug. The doses and effects of succinylcholine chloride are listed in chart form. Succinycholine chloride was found to be a relatively safe drug for immobilizing many wild animal species. However, there exists extreme variation on the dosage required to achieve the desired effect and margin of safety.

196 HINT, H.C., and A.W. Richter. 1958. A simple intravenous technique for mice. Method and some applications. Acta Pharmacol. Vol. 14, pp. 153-157, illus.

A simple intravenous infusion technique used with freely moving mice is described and illustrated. This process allows one to easily observe any symptoms during infusion. If wanted, these results may be correlated with the dose of test substance injected. Technical details on this infusion technique, along with some applications from experimental laboratory procedures, are discussed.

197 HIRATA, Miyoshi, Sumiro Isoda, Munefumi Kanao, Hiroya Shimizu, and Shin-ichi Inoue. 1970. Studies on anesthetics for fish. Bull. Jap. Soc. Sci. Fish. Vol. 36, no. 11, pp. 1127-1135.

Ninety-two anthranilate derivatives were synthesized and examined for the anesthetic effect of these compounds on goldfish and puffers. From these results, it is clear that compound No. 36, DP-1166, is the most potent anesthetic for fish. This compound also showed an excellent effectiveness on other kinds of fish.

198 HOAR, Richard M. 1965. "Anesthetic technics of the rat and guinea pig" in Experimental An. Anesthesiology, D.C. Sawyer, Ed. USAF School Aerospace Med., Brooks Air Force Base, Texas, pp. 325-343, illus.

This article discusses the handling, anesthetics, equipment, methods, drug dosages and stages of anesthesia in the rat and guinea pig. Many illustrations are included.

199 HOBSON, B.M. 1964. "The anesthetic action of di-ethyl ether, ethyl carbamate and tricaine methanesulfonate upon "Xenopus laevis." In Small Animal Anesthesia, Proc. Symp. organized by British Small An. Vet. Assoc. & Univ. Fed. for An. Welfare; London, July 1963; Oliver Graham-Jones, Ed., The Macmillan Co., New York. Pp. 47-58.

The effects of three anesthetics - ether, tricaine methanesulfonate, and urethane - were individually studied on male and female toads (Xenopus laevis). Overall, tricaine methanesulfonate was considered superior to ether or urethane as an anesthetic for Xenopus laevis. The toads injected with tricaine methanesulfonate behaved in a predictable manner and had a rapid recovery. The tolerance of toads to this drug was unaltered by repeated anesthesia. In addition, ten tadpoles, between 30 and 50 mm in length, were anesthetized by immersion in aqueous solutions of tricaine methanesulfonate.

200 HODESSON, Samuel, Sigmund T. Rich, Jessie O. Washington, and Leonard Apt. 1965. Anesthesia of the rabbit with Equi-Thesin ® following the administration of preanesthetics. Lab. An. Care. Vol. 15, no. 5, pp. 336-344.

Several drugs and combinations of drugs were tried in a search for a suitable preanesthetic agent for the laboratory rabbit. Clinical trials of a number of drugs indicated that either propiopromazine or diazepam in combination with paraldehyde were useful in preparing the subject for general anesthesia. An improved site and technique for intramuscular injection in the rabbit are described. Equi-Thesin ® was administered per rectum intravenously in varying doses to 42 rabbits following preparation with the above preanesthetics. The results obtained and the method of evaluating the depth of anesthesia are described.

201 HOGE, Robert S., Samuel Hodesson, Isabelle B. Snow, and Archie I. Wood. 1969. Intubation technique and methoxyflurane administration in rabbits. Lab. An. Care. Vol. 19, no. 5, pp. 593-595.

A refined and efficient closed-circuit apparatus for anesthetizing rabbits with methoxyflurane was developed. Because of the difficulty of visualizing the larynx in this species, a special mouth speculum was devised to aid with intubation.

202 HÖGLUND, Lars B., and Anders Persson. 1971. Effects of locomoter restraint and of anesthesia with urethane or MS-222 on the reactions of young salmon to environmental fluctuations of pH and carbon dioxide tension. Inst. Freshwater Research, Drottningholm, Sweden, Report No. 51, pp. 75-89.

Second-summer salmon parr whose movements were restrained were compared with those which were allowed to move freely, each in their respective compartments (10 x 15 x 20 cm) of a test chamber, with respect to their response to changes of pH and pCO_2 in the ambient water. Both fish remained calm in a constant flow of aerated, bicarbonate-rich Uppsala water. Short periods (40 min) of identical pH/pCO_2 variations (pH between 7.5 and 6.8 and pCO_2 between 5 and 30 mm Hg), which were repeated at regular intervals (40 min or 24 hours), induced well reproducible body movements - fluttering movements within the restraining device in the first case and excited swimming in the second - and hyperventilation. The maximal ventilation during a CO_2 test period was higher in the fish that was allowed to swim. The importance for the ventilation rate of variations in the ambient carbon dioxide tension and of an assumed difference of endogenous carbon dioxide with the different types of movements is discussed. The degree and duration of reflex disturbances induced by urethane or MS-222 were studied in unrestrained fish by repeated CO_2-response tests.

203 HOLLINGSWORTH, H., and J.R. Howes. 1965. A comparison of some new anesthetics for avian surgery. Poultry Science. Vol. 44, p. 1380. (Abs.)

A comparison between drugs was made to determine the most appropriate avian anesthetic which satisfactorily persisted over a one-hour period. Nembutal, sodium pentothal, Equi-Thesin, and Myotal were injected intravenously at various dosage levels. In addition, ether and methoxyflurane were

tried in combination, as was ether and Nembutal. Out of all the drugs tested, undiluted Nembutal was the most effective despite individual variability in dosage required for surgical anesthesia. Procaine hydrochloride, a local anesthetic, is considered the best for gastrointestinal surgery.

204 HOLMES, A.A. 1974. Immobilon in the otter. Vet. Rec.. Vol. 95, nos. 25 and 26, p. 574.

A 7-year old male otter, weighing approximately 25 pounds, was injected intramuscularly in the gluteal region using etorphine hydrochloride with acetylpromazine maleate (Immobilon, SA. Reckitt & Colman). In less than 8 minutes, the otter passed from a state of alarm and distress to full anesthesia. The animal remained anesthetized for a period of 18 minutes, maintaining a rectal temperature of 99.5° F, a respiration rate of 10/min and a heart rate between 180-210/min. Diprenorphine hydrochloride, the antagonist, was injected intramuscularly and within 6 minutes, the otter appeared fully recovered.

205 HÖNICH, M. 1970. Untersuchungen Über Wirkung von BAY-VA-1470 beim-Wild. Lab. for Game Diseases of Ministry Agriculture, Budakeszi, Hungary. Presented at XII Intl. Symp. on Diseases of Zoo Animals, Budapest, May 7-9, 1970.

Hares, pheasants, red deer, fallow deer, and mouflons were all given 10% solutions of BAY-VA-1470 to establish the action of this drug with these various species of animals. The solutions were administered intravenously, intramuscularly, and subcutaneously. Varying dosage rates were given to all those animals tested. Hares given 9.9 mg/kg of the drug intramuscularly had complete muscle relaxation for 90 minutes. Lowering the dosage of the drug in the hare resulted in incomplete muscle relaxation. Pheasants were given 5, 10, 20, 30, and 40 mg/kg intramuscularly with relaxation occurring within 4-12 minutes depending on the drug dose received.

206 HORTON, H.F. 1956. Evaluation of some physical and mechanical factors important in reducing delayed mortality of hatchery-reared rainbow trout. Prog. Fish Cult. Vol. 18, no. 1, pp. 3-14.

Sodium amytal was tested at the Roaring River Hatchery to determine its effectiveness in reducing delayed mortality in hatchery-reared rainbow trout. Sodium amytal, given at the

rate of one half grain per gallon of water, failed in reducing mortalities. The drug is reported to lose its effectiveness at 52° F and at 55° is lost completely. The symptoms of delayed mortality, the methods and apparatus used to stimulate normal transportation under which variables could be controlled and measured, and other factors affecting delayed mortality are included with this report.

207 HOUSTON, A.H., and R.J. Woods. 1972. Blood concentrations of tricaine methanesulfonate in brook trout, during anesthetization, branchial irrigation, and recovery. J. Fish. Res. Bd. Canada. Vol. 29, no. 9, pp. 1344-1346.

Blood concentrations of tricaine methanesulfonate increased rapidly upon immersion of trout in 100 mg/liter solutions of the anesthetic at 3.5-5° C and also rose significantly during irrigation for 15 minutes with either 50 or 100 mg/liter solutions. Clearance was rapid following transfer to running freshwater recovery tanks. Graphical estimates of 50 and 90% blood clearance times were 20 and 55 minutes, respectively.

208 HOUSTON, Arthur, Jane A. Madden, R. John Woods, and Harry M. Miles. 1971. Some physiological effects of handling and tricaine methanesulphonate anesthetization upon the brook trout, Salvelinus fontinalis. J. Fish. Res. Bd. Canada, Vol. 28, no. 5, pp. 625-633.

The effects of handling and anesthetization with tricaine methanesulphonate (Ayerst "Finquel") upon brook trout (Salvelinus fontinalis) have been investigated with reference to selected hematological and cardioventilatory parameters and several aspects of body fluid chemistry. Alterations in hemoglobin, hematocrit, and total solids suggest that exposure to the anesthetic prompts a rapid hemoconcentration. Water content increases and the plasma, tissue, and estimated cellular levels of several of the major electrolytes (sodium, potassium, calcium, and magnesium) are altered. Observations upon cardiac activity, dorsal aortic pressure, and ventilatory rate and amplitude support the hypothesis that Finquel exerts a depressive influence upon central autonomic functions. Handling alone leads to significant changes in plasma, glucose, and lactate levels and in the concentrations and distributions of a number of the electrolytes investigated.

209 HOUSTON, Arthur H., Jane A. Madden, R. John Woods, and Harry M. Miles. 1971. Variations in the blood and tissue chemistry of brook trout, Salvelinus fontinalis, subsequent to handling, anesthesia, and surgery. J. Fish. Res. Bd. Canada, Vol. 28, no. 5, pp. 635-642.

Modifications in blood and tissue chemistry of brook trout have been followed during their recovery from handling, tricaine methanesulphonate (Ayerst "Finquel") anesthesia, and experimental preparation. The recovery process was characterized by alterations in the hematological characteristics of the animals; a marked and persistent condition of hyperglycemia; changes in plasma, tissue, and estimated cellular ion concentrations; and equilibrium potentials. Water content remained relatively stable, although variations in distribution took place. The short-term changes observed appeared to be correlated in time with the clearance of anesthetic from the animals and possibly with a sequence of cardioventilatory-renal reflex responses induced by vascular hypoxia (or hypercapnia). More persistent changes are believed to be related to generalized endocrine responses to the traumatic character of the procedures employed.

210 HOUSTON, D.C., and J.E. Cooper. 1973. Use of the drug Metomidate to facilitate the handling of vultures. International Zoo Yearbook. Vol. 13, pp. 269-271.

The drug, Metomidate, has been found to be ideal for short-term immobilization of large birds. A suitable dose for all vulture species was determined at 3-4 mg/kg body weight. One fine attribute of the drug is that the depth and duration of hypnosis or anesthesia may be varied by finely adjusting the dose value. Metomidate is injected into the pectoral muscle and the bird is immediately released. Within 2-5 minutes, after a normal dosage has been given, the bird's eyes start to close and the head droops. After a short time, the bird may be freely handled. Recovery is gradual, spanning over a 2-hour period. No distress or alarm was noted in birds coming out of anesthesia and hypnosis. A chart listing the dose of Metomidate given to produce hypnosis and anesthesia in four species of vulture is included.

211 HOWELL, John H., and Paul M. Thomas. 1964. Anesthetic effect of 4-styrylpyridine on lamprey and fish. Trans. Amer. Fish. Soc. Vol. 93, no. 2, pp. 206-208.

Experiments were conducted on 4-styrylpyridine (4-SP) to determine its anesthetic qualities. The following animals were exposed to 4-SP: American brook lamprey (Lamptera lamottei; adults and larvae), sea lamprey (Petromyzon marinus; adults and larvae), white sucker (Catostomus commersoni), pumpkinseed (Lepomis gibbosus), yellow perch (Perca flavescens), fathead minnow (Pimephales promelas), and rainbow trout (Salmo gairdneri). Fish and lamprey were exposed to 4-SP in 10 liter glass battery jars containing 6 liters of test solution. By use of a constant-temperature bath, the jars were maintained at 55° F. Compressed air was delivered through stone airbreakers. The concentration of 4-SP was determined according to the expected susceptibility. Due to the low solubility of 4-SP in water, the maximum concentration any animal was subjected to was 50 ppm. In most cases, increased dosage usually shortened the time required to produce anesthesia. Larval lamprey, as a group, were the most highly resistant to the anesthetic effects of 4-SP. Out of a total of 295 lampreys and fishes exposed to 4-SP during these experiments, only a 4.4% mortality rate was noted.

212 HOWLAND, Robert M., and Richard A. Schoettger. 1969. Efficacy of methylpentynol as an anesthetic on four salmonids, No. 29. In Investigations in Fish Control. U.S. Dept. of Interior, Bur. Sport Fish. & Wildl. 11 pp.

Effective concentrations of methylpentynol for anesthetizing rainbow, brown, brook, and lake trout were determined by a series of tests. Concentrations of 1.5-8 parts per thousand induced anesthesia in 4-57 minutes. Increase in water temperature accelerated anesthesia. Change in pH or in water hardness had no significant effect on the rate of anesthesia. Repeated anesthesia had little effect on rate of response. The efficacy of anesthetic solutions was reduced by continuous use. Approximately 1 kg of rainbow trout could be effectively narcotized per ml of drug. Methylpentynol was compared with MS-222 as a fish anesthetic. Fifty-times as much methypentynol was necessary to yield the equivalent effect of 100 ppm of MS-222. Methylpentynol may be more appropriate as a sedative or soporific for salmonids than as an anesthetic.

213 HUBBARD, Richard C. 1969. Chemotheraphy in captive marine mammals. Proc. Ann. Con. - Bull Wildlife Disease Assoc. Vol. 5, no. 3, pp. 218-230.

An excellent paper giving a good overview on chemotherapeutic agents that may be used in seals (pinnipeds) and whales (cetaceans). A few comments are also made on sea otters (Enhydra lutris). Case examples are reported with recommendations given to the choice of drug and amount. General and local anesthetics as well as narcotic and other analgesics are discussed. Tranquilizers may be used with cetaceans, but with extreme caution due to the animal's sensitivity to these drugs. Information is also included on antimicrobial agents, hormones, vitamins, antihistimines and endoparasitic diseases.

214 HUBLOU, Wallace F. 1957. A method of using an anesthetic in marking fins. Prog. Fish Cult. Vol. 19, no. 1, pp. 40-43.

The Oregon Fish Commission developed a satisfactory method of applying an anesthetic in a closed recirculating system. This system allows fingerling salmon and steelhead trout to effectively have their fins marked. An overall improvement of 49.5% was noted in the marking rate, as compared with previous procedures where an anesthetic was not used. The method, equipment, and procedures necessary for this system setup are discussed.

215 HUGHES, J.S. 1969. Toxicity of therapeutic agents to striped bass. Dingell-Johnson Report, Louisiana, Proj. # F-015-R-02/J-06. 4 pp. (DPL-FWRS 17-7240116).

Several anesthetics and therapeutic agents were experimentally tested on various sizes of striped bass. Striped bass larvae survived in a solution of 0.1 g of MS-222 per gallon of water for 72 hours but were not narcotized. By using a concentration of 0.2 g of MS-222 per gallon of water, the fish were narcotized 2.5 minutes. A series of tests were also performed allowing the fish to remain in the MS-222 for varying periods of time and then their recovery time was recorded. Studies also mentioned in this report include using copper sulfate, potassium permanganate, and dylox.

216 HUISH, Melvin T. 1972. Some responses of the brown bullhead to MS-222. Prog. Fish Cult. Vol. 34, no. 1, pp. 27-32.

The purpose of this study was to find out: the time required to induce anesthesia in the brown bullhead (Ictalurus nebulosus) at varying concentrations, the effect of temperature on depth and time of induction at given concentrations, the induction time and differences with size of fish; and the mortality and rate of recovery with varying concentrations and temperatures. As expected, the stronger doses of MS-222 produced the strongest reactions. Concentrations of 75 or 100 ppm quickly immobilized the brown bullhead. Slight differences were noted in the time required for induction to achieve the various stages of anesthesia with varying fish size. The time required to produce immobilization did not differ greatly at different temperatures; however, recovery and survival of small fish were affected by higher temperatures. Results obtained indicate that when MS-222 is employed with temperatures of 22° C or above, the drug should be used carefully to reduce losses.

217 HUNN, Joseph B. 1970. Dynamics of MS-222 in the blood and brain of freshwater fishes during anesthesia, No. 42, In Investigations in Fish Control. U.S. Dept. of Interior, Bur. of Sport Fish. & Wildl. Pp. 3-8.

Eleven species of freshwater fishes were rapidly anesthetized in solutions of MS-222 containing from 100-1,000 mg of MS-222 per liter. MS-222 rapidly diffuses across the gill and passes the blood-brain barrier. Evidence of metabolism of the drug was seen in the presence of acetylated MS-222 in the brain of all species studied. The concentration of free MS-222 in the brain increased with depth of anesthesia to loss of reflex and then either increased or declined slightly as the fish approached medullary collapse.

218 HUNT, T.J. 1964. "Anesthesia of the tortoise" in Small Animal Anesthesia, Proc. Symp. organized by British Small An. Vet. Assoc. & Univ. Fed. for An. Welfare; London, July, 1963; Oliver Graham-Jones, Ed., The Macmillan Co., New York. Pp. 71-76, illus.

This paper reports and summarizes work and methods of anesthesia on the tortoise, Testudo g. graeca L. Over 290 animals, both juvenile and adult, were used. Three anesthetics - ether, pentobarbital sodium, and tribromoethanol - are discussed with information on drug dose, methods of administering the drug, and the duration of anesthesia. Also included are notes on pre- and postoperative care and anesthetizing terrapins and turtles.

219 JEFFREY, N.B. 1970. Spawning the grass carp. Dingell-Johnson Report, Alabama, Proj. # F-010-R. Vol. 2, no. 2, p. 3. (DPL-FWRS 01-7410262).

During experimental work to breed the grass carp (Ctenopharyngodon idella) by the injection of pituitary extract, an easier means of handling was necessary. A 1:1,000 quinaldine water solution was used as an anesthetic and this greatly facilitated the injection, handling, and stripping of the fish. The gills of the breeders were sprayed with the prepared solution.

220 JEWELL, P.A. and E.A. Smith. 1965. Immobilization of grey seals. J. Wildl. Manage. Vol. 29, no. 2, pp. 316-318.

The purpose for this research was to find a suitable method of restraining grey seals (Halichoerus grypus) for marking. Only cows that were not suckling pups were restrained. Both suxamethonium (methyl derivative of succinylcholine) and suxethonium (ethyl derivative of succinylcholine) were used, with the best results obtained from suxethonium at 0.5 mg/lb. Problems encountered were incomplete immobilization due to drug being injected into a 2-inch blubber layer with resulting slow absorption, syringes bouncing off the resilient side of the animals, and faulty drug discharge devices.

221 JOHNSON, Frank M., Jack Stubles, and Ralph A. Klawitter. 1964. Rodent repellent value of Arasan-Endrin mixtures applied to acorns. J. Wildl. Manage. Vol. 28, no. 1, pp. 15-19.

A mixture of Arasan 75 and Endrin 50W was tried in two concentrations on acorns of Shumard oak (Quercus shumardii) and swamp chestnut oak (Q. michauzii) to determine its effectiveness in protecting acorns from damage by gray squirrels (Sciurus carolinensis) and cotton rats (Sigmodon hispidus). Treated and untreated acorns were exposed to 12 gray squirrels and 12 cotton rats in a series of cage tests. The repellent was effective against both squirrels and cotton rats when untreated acorns were also available. It was quite effective against cotton rats, but not against squirrels, when only treated acorns were available. In periods of abundant alternate food supplies, a direct seeding of treated acorns should produce a good stand, but this may not be true under adverse food conditions.

222 JOHNSON, Harlan E., and J.M. Shelton. 1958. Marking chinook salmon fry. Prog. Fish Cult. Vol. 20, no. 4, pp. 183-185.

Ten to twenty chinook salmon fry at a time were captured in a small net and immersed in a 1:7,500 solution of tricaine methanesulfonate (MS-222). As soon as the fish turned over on their sides due to the anesthetic, fin clipping took place. Fin clipping continued even after the fish had been transferred from the anesthetic to fresh water. The last fish was marked just before it recovered from the drug. A total of 487,000 fry were marked using MS-222.

223 JOHNSON, Leon D. 1954. Use of urethane anesthesia in spawning eastern brook trout. Prog. Fish Cult. Vol. 16, no. 4, pp. 182-183.

Urethane anesthesia proved of value for the taking of spawn from eastern brook trout. An approximate 25-percent reduction in work time was attributed to the use of anesthesia. Similar results in the percentage of egg hatch and brood stock survival handled with and without urethane anesthesia were also noted. In addition, trout given urethane daily showed no ill effects. For 15 consecutive days, 5 selected fish were immersed in 0.5 percent solution with no mortality.

224 JOLLY, D. W., L. E. Mawdesley-Thomas, and D. Bucke. 1972. Anaesthesia of fish. Vet. Rec. Vol. 91, pp. 424-426.

Fish can be sedated or anesthetized by immersion in a solution of an anesthetic agent which is absorbed into the blood stream through the gill lamellae. Anesthesia can be induced within one to two minutes with a solution of 25-300 mg/litre of tricaine methanesulphonate and within one minute using one to four ppm of propoxate. The anesthetized fish can be removed from water, placed on a damp cloth, and subjected to a surgical or diagnostic exercise. When returned to clean water the fish recovers within 5-10 minutes. The effects of a number of their anesthetic agents have been assessed.

225 JONES, D.M. 1977. The sedation and anaesthesia of birds and reptiles. Vet. Rec. Vol. 101, pp. 340-342.

Demand for veterinary care of birds and reptiles is increasing and with it a knowledge of the current methods of restraint and sedation of these classes. Some of the safer and more

practical methods are reviewed and commented on in the light of recent results from the Zoological Society of London's veterinary department.

226 JONES, D.M., and A.K. Fitzgerald. 1977. Location of metal fragments in a python. Mod. Vet. Practice. Vol. 58, no. 10, p. 861.

A 4-m-long African Rock python, with a reported history of having been shot by its owner, was sedated with ketamine hydrochloride given intramuscularly at a dose of 40 mg/kg. The following day, after the condition of the snake had been determined, the snake was once again sedated with ketamine hydrochloride and intubated with a 4.5 mm cuffed endotracheal tube. Using a mixture of halothane and oxygen in a closed circuit system, anesthesia was induced and maintained for 6 hours. A total of 8 22-caliber rifle pellets were removed from the snake.

227 JONES, J. B., and M. L. Simmons. 1968. Innovar-Vet® as an intramuscular anesthetic for rats. Lab. An. Care. Vol. 18, no. 6, pp. 642-643.

Innovar-Vet® (McNeil Laboratories; Fort Washington, Pennsylvania) was injected intramuscularly as the only anesthetizing agent in 19 rats undergoing splenectomy. An additional group of 11 animals received the same range of doses but were not splenectomized. Doses ranged from 0.01-0.03 cc per 100 g of body weight. One Long-Evans rat, weighing 110 g and receiving 0.03 cc per 100 g, died 7 minutes after the injection without undergoing surgery.

228 JONES, Ronald S. 1966. Halothane anesthesia in turkeys. British Journal of Anaesth. Vol. 38, no. 8, pp. 656-658.

An anesthetic technique employing halothane in oxygen for use in adult turkeys is described. The mixture was administered using a Magill attachment and a Hall cat mask. Induction was rapid and excitement free. Anesthesia was maintained for varying periods of time up to a maximum of 80 minutes. Recovery was rapid. In a total of 25 turkeys, no deaths occurred which were attributable to the anesthetic.

229 JORDAN, Reginald D., and Carl T. Kyzar. 1978. Intra-abdominal removal of eggs from a gopher tortoise. Vet. Med./SAC. Vol. 73, no. 8.

A gopher tortoise (Gopherus polyphemus) weighing 11.88 lbs was unable to expel eggs. Finally, after 5 days, it was decided to remove the eggs surgically. Initially, the tortoise was preanesthetized with 5 mg Acepromazine Maleate (Ayerst) given intramuscularly and surgical anesthesia was induced with 200 mg ketamine hydrochloride (Vetalar® -Parke Davis). Postoperative recovery was uneventful, but 8 days after surgery, the tortoise died. No necropsy was performed.

230 KACZMARCZYK, G., and H. W. Reinhardt. 1975. Arterial blood gas tensions and acid-base status of Wistar rats during thiopental and halothane anesthesia. Lab. An. Science. Vol. 25, no. 2, pp. 184-190.

Arterial blood gas tensions and acid-base status of spontaneously-breathing, unanesthetized Wistar rats were compared with values obtained during 4 hours of thiopental and 6 hours of halothane (1%) anesthesia. During thiopental anesthesia, marked respiratory depression occurred. Thirty-six percent of the rats died. During inhalation of room air and 1% halothane, PaO_2 decreased also, whereas $PaCO_2$ did not change. Twenty-seven percent of the original number of rats died. Lowered arterial oxygen tension may have caused death; no rats died during inhalation of oxygen and 1% halothane. This technic insured sufficient analgesia for surgical procedures without marked alterations of the acid-base status and is recommended for long-term anesthesia of small laboratory animals like rats.

231 KAPLAN, Harold M. 1969. Anesthesia in amphibians and reptiles. Fed. Proc. Vol. 28, no. 4, pp. 1541-1546.

An excellent overview on the use of anesthesia in amphibians and reptiles. The animals mentioned include: frogs, salamanders, newts, turtles, snakes, lizards, alligators, and crocodiles. The choice of agents available, the drug dosages, the various methods of administering the drugs, and necessary precautions are mentioned.

232 KAPLAN, Harold M., and Martin Kaplan. 1961. Anesthesia of frogs with ethyl alcohol. Proc. Animal Care Panel. Vol. 11, no. 1, pp. 31-35.

Fifty-two grass frogs (Rana pipiens) were successfully anesthetized when immersed in a 10% solution of ethyl alcohol. The 3-inch frogs normally reached a deep stage of anesthesia within 10 minutes, at which time the frog was transferred to tap water. The surgical duration was approximately 19 minutes and could be lengthened by retention in alcohol. Factors affecting the duration of anesthesia included the size and sex of the frog and environmental temperature.

233 KAPLAN, Harold M., and Richard Taylor. 1957. Anesthesia in turtles. Herpetologica. Vol. 13, pp. 43-45.

Ether, Nembutal (sodium pentobarbital) and urethane were used to anesthetize adult turtles (Pseudemys spp.) All 3 of these drugs produced "surgical" anesthesia. Urethane was found the least satisfactory due to a long induction/recovery period. The effective doses were also found to be too high using urethane. The effective drug dosages, time necessary to obtain anesthesia, and other information are included in this paper.

234 KAPLAN, Harold M., N. R. Brewer, and Martin R. Kaplan. 1962. Comparative value of some barbiturates for anesthesia in the frog. Proc. Animal Care Panel. Vol. 12, no. 4, pp. 141-148.

Frogs (Rana pipiens) can be safely and predictably brought to a plane of surgical anesthesia with either sodium hexobarbital (120 mg/kg through the dorsal lymph sac), or with sodium pentobarbital (60 mg/kg intraperitoneally or through the dorsal lymph sac). Sodium barbital, sodium thiopental, a diallylbarbituric acid-urethane mixture, and chlorpromazine by itself or in combination with pentobarbital did not prove to be safe anesthetics for R. pipiens.

235 KARLSTROM, E. L., and Sherburne F. Cook, Jr. 1955. Notes on snake anesthesia. Copeia. No. 1, p. 57-58.

Three anesthetics - pentothal sodium (thiopental sodium), Nembutal (pentobarbitol sodium), and MS-222 (tricaine methanesulfonate) - were used to anesthetize snakes. Each juvenile snake (5-10 g) received less than 1 cc solution while the larger snakes (200-370 g) were injected with 5 cc or more. All injections were ventrally placed into the middle of the pleuroperitoneal cavity, avoiding the pericardial region. On the basis of the experiments performed, all the anesthetics

gave comparable, good results and no drug was preferred over the other. Factors involved in anesthetizing snakes, handling procedures, and general information on the anesthetics are included.

236 KELLY, George M. 1973. The biology of an isolated porcupine population. A thesis submitted to the graduate school of University of Mass. in partial fulfillment of the requirements for the degree of Master of Science. 61 pp.

In order to collect more data and information of porcupines (Erethizon dorsatum), the animals were captured and then anesthetized with an inhalant, either Metafane (Pitman-Moore, Inc., Washington Crossing, New Jersey) or ether. The anesthetic was administered by placing a cone, containing saturated cotton, over the animal's head while the animal was held by the tail. Anesthesia lasted for approximately 15-30 minutes. Due to such varied reactions to the inhalant, care had to be taken when administering the drug. The thesis also presents information on the porcupines' population structure, behavior, range, and movement.

237 KENNEDY, J. P., and H. L. Brockman. 1965. Open heart surgery in Alligator mississipiensis Daudin. Herpetologica. Vol. 21, no. 1, pp. 6-15, illus.

This paper describes a technique for open heart surgery in Alligator mississipiensis Daudin. Before surgery, while the alligators were still restrained within canvas bags, they were placed in a cold room which had a temperature of approximately 40° C. The alligators remained there for 12-16 hours. This period of time and degree of cold were insufficient to completely immobilize the animals for surgery. In order to induce deep hypothermia, the alligators within the bags had to be placed into a deep freeze with a temperature of -48° C. The animals were kept in the deep freeze for 25 minutes to 1 hour. Cloacal temperatures were then taken and these ranged from 2.5 to 8° C. At these temperatures, the reptiles were adequately immobilized for surgery.

238 KENT, Geraldine M. 1971. General anesthesia in rabbits using methoyflurane, nitrous oxide, and oxygen. Lab. An. Science. Vol. 21, no. 2, pp. 256-257.

A safe and effective method of inducing and maintaining surgical anesthesia in rabbits is described. After preanesthetic tranquilization with acetylpromazine maleate 1 mg/kg, anesthesia was induced with methoxyflurane by the open drop method and maintained with a mixture of methoxyflurane, nitrous oxide, and oxygen.

239 KEYS, A.B., and N.A. Wells. 1930. Amytal anesthesia in fishes. J. of Pharmacol. Exptl. Therap. Vol. 40, no. 1, pp. 115-128.

This paper reports on experiments using the drug amytal in the induction of complete anesthesia in fish. In the 4 species of fish studied, the optimum dosage to produce complete anesthesia was found to be 40-54 mg of amytal/kg of fish. The fish were anesthetized from 4-18 hours using this drug dosage guideline. To secure optimum results, it was suggested that the age of the fish be considered. Younger fish were affected more so than older and larger fish. No evidence was shown to indicate a cumulative effect of the drug or of an acquired tolerance to its action. The effects of amytal on the physiologic aspects of the fish are also detailed. All movements but those of respiration and heart action could be completely cessated by the intraperitoneal injection of the alkaline solution of amytal diluted in Ringer's solution.

240 KITTLE, Earl L. 1971. Ketamine HCl as an anesthetic for birds. Mod. Vet. Practice. Vol. 52, no. 10, pp. 40-41, illus.

Ketamine hydrochloride is considered a safe and effective anesthetic for birds. A dose of 100 mg/lb (10 mg/45 gm) given intramuscularly induced general anesthesia in experimental pigeons. Other case examples are described using ketamine hydrochloride in injured birds. The injured birds included an adult red-tailed hawk, a green heron, a black vulture, and a screech owl. The author of this article suggests that further investigation may be needed to establish a safe dosage of ketamine hydrochloride for debilitated birds.

241 KITTLE, Earl L. 1972. Ketamine hydrochloride as an anesthetic for birds. Raptor Research. Vol. 6, no. 2, pp. 49-50.

Ketamine hydrochloride was experimentally tested on a variety of birds. General anesthesia could be induced in pigeons with a dose of 100 mg/lb (10 mg/45 g) given intramuscularly. During a 4-week period, the pigeons were anesthetized 5 times

with 100 mg/lb of ketamine hydrochloride. No deaths or visible side effects were noted. Other case examples mentioned include intramuscular anesthetization of injured birds. The injured birds treated with the drug include an adult red-tailed hawk, a green heron, a black vulture, and a screech owl. In the testing done, 100 mg/lb seemed a little high for birds of prey. Therefore, an initial injection of 50 mg/lb followed by increments of 25 mg/lb as needed worked better. Surgery usually required more ketamine hydrochloride.

242 KLIDE, A.M. 1973. Avian Anesthesia. Veterinary Clinics of N.A. Vol. 3, pp. 175-186.

243 KLIDE, A. M., and L. V. Klein. 1973. Chemical restraint of three reptilean species. J. of Zoo An. Med. Vol. 4, no. 1, pp. 8-11.

In order to move an American crocodile (Crocodylus acutus) and a mugger (Crocodylus palostrus) into the new reptile house at the Philadelphia Zoological Gardens, chemical restraint was used. Due to the lack of information on chemical restraint of different species of reptiles, experimentation took place on caimans (Caiman crocodylus). Tricaine, pentobarbital sodium, and succinycholine chloride were tried on the caimans. As it turned out, the responses obtained from the caimans were quite different from published results of the American alligator. Nevertheless, after consideration, it was decided to use succinylcholine on the crocodiles. Administering the proper quantities of this drug was found difficult due to syringes bouncing off the skin or breaking. A more rapid and consistent effect occurred when the drug was injected through the hind leg. A description of the trials that took place is included.

244 KLONTZ, George W. 1965. Anesthesia of fishes. In Experimental An. Anesthesiology. D. C. Sawyer, Ed. USAF School Aerospace Med., Brooks Air Force Base, Texas. Pp. 350-373.

A brief description is given on 15 agents that have been used to anesthetize fish. Included is a summary of the recommended concentrations and the relative anesthetic properties. No particular reference to any fish or water temperature is given in these descriptions. Technical requirements for the induction and maintenance of anesthesia of fish are also discussed.

245 KNIGHT, Alexis E. 1964. Intracellular hemoglobin crystallization in two centrarchids, the largemouth bass and the bluegill. Prog. Fish Cult. Vol. 26, no. 3, pp. 115-117.

By means of cardiac puncture or severing the caudal peduncle, blood samples were obtained from fish anesthetized in a 1:5,000 solution of tricaine methanesulfonate (MS-222).

246 KRANER, Keith L., Arthur M. Silverstein, and Charles J. Parshall, Jr. 1965. Surgical anesthesia in snakes. In Experimental An. Anesthesiology. D. C. Sawyer, Ed. USAF School Aerospace Med., Brooks Air Force Base, Texas. Pp. 374-378.

Various methods of anesthetization were tried on snakes so that surgical procedures could be performed easier. Two barbiturates, sodium thiopental and sodium thiamylal, were administered intraperitoneally at drug doses of 2-6 mg/kg body weight. These drugs had to be given at nearly lethal drug dosages in order to be effective and recovery required 40 to 72 hours even when stimulants were used. A gaseous mixture of halothane vapor, nitrous oxide, and oxygen was then tried and found to be satisfactory. This gaseous mixture was introduced into a clear plastic bag along with the snake. After an induction period lasting approximately 30 minutes, an endotracheal tube was inserted and anesthesia was continued during surgery. After ventilation with pure oxygen, recovery was extremely rapid.

247 KRAPU, Gary L. 1976. Experimental responses of mallards and Canada geese to tribromoethanol. J. Wildl. Manage. Vol. 40, no. 1, pp. 180-183.

Research done at the Northern Prairie Research Center, Jamestown, North Dakota, provided additional experimental information on the effectiveness of tribromoethanol for capturing waterfowl. Research was conducted indoors in laboratory facilities with mallards (Anas platyrhynchos), and experimentation of Canada geese (Branta canadensis) was completed in a flight-pen environment. Ninety-six incubator hatched mallards were stratified by age and randomly assigned to varying feed treatments in groups of 16. A 2-percent solution at a drug dosage of 150 mg/kg of body weight was administered to the mallards by proventricular intubation with a syringe calibrated to a precision of 0.1 cc. The geese received a dosage of tribromoethanol ranging from 17.6-117.3 g/kg. In 9 tests, where 165 geese fed at bait sites received drug dosages

from 35.2-117.3 g/kg, 30 (18 percent) were immobilized. The author suggests the potential user know the limitations and advantages of tribromoethanol when considering the capture of waterfowl out in the field. Many birds escaped under subeffective narcosis, and, therefore, a careful selection of sites for baiting and drugging the birds is necessary. Three charts, summarizing the data acquired in this study, are included.

248 KRUPP, Jerome H. 1964. A review of the opossum in research-husbandry, experimental techniques and routine health measures. Abst. 14th An. Mtg. An. Care Panel. Ambassador Hotel; Los Angeles, California. October 1-4, 1963.

Increased use of the opossum in a variety of studies has focused attention on some of the problems attending their use. Feeding, handling, and general husbandry are discussed from the viewpoint of experience gained in supervising an opossum breeding colony. Techniques for intravenous, intraperitoneal, and subcutaneous injection are explained and illustrated. Special attention is given preventive health measures relating to ectoparasites and intestinal helminths.

249 KRUPP, Jerome H., and Richard Quillin. 1964. A review of the use of the opossum for research-husbandry, experimental techniques and routine health measures. Lab. An. Care. Vol. 14, no. 3, pp. 189-194.

Due to the increased interest in using the opossum as a research animal, a need to successfully anesthetize these animals became necessary. Fortunately, anesthesia was easily administered to these animals using ether or sodium pentobarbital. Sodium pentabarbital given intravenously at 36 mg/kg gave safe, satisfactory anesthesia. To maintain surgical anesthesia over a prolonged period of time, an average of 25 mg/kg/hour of alpha-chloralose was used for longer experiments giving a wide margin of safety. Once induction was obtained with a 4% sodium pentothal solution, alpha-chloralose was used at a level of 12 mg every 2 hours. The paper also includes other information on the opossum and using this animal for experimental needs.

250 KUEHN, Gary. Anesthesia in turtles. 1974. J. of Zoo An. Med. Vol. 5, no. 3, p. 35.

Due to an accident, a 135-lb male alligator snapping turtle (Macrochelys temmincki) sustained bilateral transverse mandibular fractures. Special problems arose during the anesthetizing of this animal as his snapping behavior remained long after pinprick and pinch reflexes had disappeared. After several attempts, satisfactory anesthesia was reached using Equi-Thesin at a rate of 45 cc intramuscularly plus 45 cc intraperitoneally. Recovery from anesthesia did not appear complete until the fifth day. Pulmonary edema, which occurs frequently in anesthetized turtles of a variety of species, may easily be controlled using atropine sulfate. Atropine sulfate has successfully been given intramuscularly, intraperitoneally, or subcutaneously.

251 LANCIA, Richard A., Robert P. Brooks, and Michael W. Fleming. 1978. Ketamine hydrochloride as an immobilant and anesthetic for beaver. J. Wildl. Manage. Vol. 42, No. 4, pp. 946-948.

Increases in populations of beaver have precipitated a need for an easily administered immobilizing and anesthetic agent in order to handle live beaver for translocation. In addition, a suitable immobilizing anesthetic agent was desired for research and clinical use as well as to simplify sex identification. Since injectable and inhalation anesthetics have been used in the past without complete satisfaction, ketamine hydrochloride (Ketaset, Bristol Laboratories, Syracuse; Vetalar, Parke-Davis and Co., Ann Arbor) was used in combination form with acepromazine maleate (Anatran, Ayerst Laboratory, New York). Both drugs were administered into the gluteal muscles and recovery was rapid. The combined drug was given to all sex and age classes at various dose levels for both field and clinical use. Drug dosages for the various age groups are included within this report. Over a 1 year period, some beavers were immobilized as many as 5 times and showed no ill effects. One weakened beaver did die. Therefore, it is suggested that discretion be used on these types of animals which are not well.

252 LANGE, Robert E., Jr. 1978. Delivery systems used in immobilization procedures. Chemical Immobilization Session of WDA; Wildlife Diseases Program, August 2, 1978.

The various types of delivery systems for immobilizing animals are described. The three basic delivery systems are for long, medium (less than 25 feet), and short (less than 5 feet) distances. The short-distance delivery system is almost

always used in combination with some type of entrapment device. Push-pole syringes and hand-held syringes work extremely well on animals that are closely confined but not docile. Mortalities are rare using the push-pole syringe. The long-distance delivery system is specifically for larger animals.

253 LANZING, W.J.R. 1971. Effects of some anesthetics on laboratory reared Tilapia mossambica (Cichlidae). Copeia. No. 1, pp. 182-185.

On culturing Tilapia, a number of anesthetics were tested regarding their economy, convenience of application, reaction time, and reliability. Tilapia may take 6 minutes to reach full or state IV anesthesia at a MS-222 concentration of 0.2 g/liter. Propoxate is apparently the most potent anesthetic, since a concentration as low as 0.001 g/liter is capable of inducing loss of equilibrium in 22 minutes. Urethane and chloral hydrate have the lowest potency of the drugs tested. Urethane induces sluggishness when the fish are exposed to concentrations of 0.5-5.0 g/liter for 30 minutes. Chloral hydrate induces convulsions at 20.0 g/liter and full anesthesia is obtained after 20 minutes in a 21.0 g/liter solution. These two drugs seem to be useful only in concentrations that approximate osmotically hypertonic media. Quinaldine induces anesthesia almost instantaneously at concentrations of 2.0 g/liter or higher. The choice of a particular anesthetic depends mostly on research requirements. If short induction periods are essential, the choice may be MS-222 or quinaldine. For high potency or long recovery periods, propoxate will be useful. Propylene phenoxetol is in some respects similar to chlorbutol. Chlorbutol is probably the most economical drug. It is a fairly common chemical (which means no problem of supply); also, it is a stable product and less harmful to the fish than some of the other drugs tested.

254 LARSEN, Howard N. 1964. Comparison of various methods of hemoglobin determination on catfish blood. Prog. Fish Cult. Vol. 26, no. 1, pp. 11-15.

Two-year old channel catfish (Ictalurus punctatus) were anesthetized in a 1:5,000 solution of tricaine methanesulfonate (MS-222) to simplify obtaining blood.

255 LEFEBVRE, Lynn W. 1978. Repellency of methiocarb-treated corn seed to fox squirrels. Wildl. Soc. Bull. Vol. 6, no. 4, pp. 231-234.

Methiocarb-treated corn seed was tested on fox squirrels (Sciurus niger) to evaluate its repellency and primary hazard to this species. Ten captive fox squirrels were offered several choices of untreated and treated food. Squirrels consumed significantly less untreated dog food than untreated corn seed ($P<0.01$), less methiocarb-treated corn than untreated corn ($P<0.01$), and less treated corn than untreated dog food ($P<0.01$). All squirrels survived an 18-day period when only methiocarb-treated corn was offered; mean weight loss (127 g) during this period was significant.

256 LEININGER, F.G. 1965. Clinical use of methoxyflurane anesthetic in small animal practice. Vet. Med./SAC. Vol. 60, no. 4, pp. 401-405.

The use of methoxyflurane anesthetic in clinical practice is described. Methoxyflurane was tested in order to determine its safety, practicality, and efficacy, especially in poor surgical risk patients. Anesthesia was induced in a skunk when a glass jar containing a small piece of gauze soaked in the drug was used. The depth of anesthesia was sustained with a paper-cup type cone. The anesthetic proved to be safe, giving excellent muscle relaxation and possessing excellent analgesic properties.

257 LEITRITZ, Earl, and Robert C. Lewis. 1976. Trout and salmon culture: Hatchery methods. Calif. Dept. Fish & Game; Fish Bull. 164. Pp. 26-28, 137, and 167, illus.

Fishery workers have used anesthetics on fish for quite some time as an aid in fish transportation, fin clipping and spawn taking. MS-222 (tricaine methanesulfonate) is discussed on pages 26 and 167, while carbon dioxide is mentioned on page 167 of this publication. Sodium amytal, a hypnotic barbiturate, is discussed on page 137. Sodium amytal is very useful in fish transportation, producing a long lasting tranquilizing effect on trout and salmon. Drug dosages are included.

258 LEVI, Herbert W. 1958. Pharmacology and toxicology of nicotine with special reference to species variation. Science. Vol. 127, no. 3305, pp. 1054-1055.

This article discusses the results of many experiments that have taken place with reference to the use of nicotine. The physiological responses, toxicity between the two isomers of nicotine, and the pharmacology of the drug are discussed. Some of the smaller animals tested with nicotine include rats, rabbits, mice, and pigeons. In one experiment, all the animals received chemically pure, unbuffered, I-nicotine of pH 8.4 or the equivalent amount of nicotine salt. Both forms of the drug were administered intramuscularly. A table listing the minimal paralytic dose of nicotine and the approximate lethal dose of 14 species studied is included.

259 LEVINGER, I.M. 1973. A new anesthetic-sedative agent for birds. British Vet. J. Vol. 129, no. 3, pp. 296-300.

The sedative action of Bay Va 1470 (Rompun, Bayer Ltd.) was tested on birds of 9 species in about 90 experiments. The drug was injected intramuscularly in various doses in each animal and its effect was determined. It was found that the substance showed a very strong sedative action, with a very rapid onset. The lethal dose was very high compared with the active sedative analgesic one; it thus offered a very wide safety margin. It seems that this drug can solve the problem of handling birds during transportation and may also be used for medical operations.

260 LINDQUIST, Peter A. 1972. Induction of methoxyflurane anesthesia in the rabbit after ketamine hydrochloride and endotracheal intubation. Lab. An. Science. Vol. 22, no. 6, pp. 898-899.

Ketamine HCl was injected intravenously into rabbits (15-20 mg/kg) to facilitate endotracheal intubation followed by methoxyflurane administration. Anesthesia was achieved in 5 minutes or less. No adverse reactions were noted at the dosages employed.

261 LINDSEY, G.D., R.M. Anthony, and J. Evans. 1974. Mestranol as a repellent to protect Douglas-fir seed from deer mice. Proc. Vertebrate Pest Conf. (Univ. California, Davis). Vol. 6, pp. 272-279.

Mestranol was tested at 2% (active) as a repellent for protecting Douglas-fir (Pseudotsuga menziesii) seed from deer mice (Peromyscus maniculatus). In 5-day laboratory bioassays, deer mice consumed 61%-66% fewer mestranol-treated seeds than

control seeds. Deer mice showed a progressive aversion to the mestranol seed treatment from 24%-76% in 5 days. Thereafter, with minimal reinforcement, avoidance was maintained at 90%-99% for 6 months. In six field trials in Washington, Oregon, and California, areas seeded with 2% mestranol-treated Douglas-fir seed yielded 1.6-5.9 times more germinants than areas seeded with control seed.

262 LINDZEY, James S. 1960. Research on control of blackbird depredations. Trans. 25th North Am. Wildl. & Natl. Res. Conf. No. 25, pp. 116-121.

The problems in bird-depredation control are discussed with chief attention being given to redwinged blackbirds (Agelaius phoeniceus) and grackles (Quiscalus spp.) because of their widespread distribution and their importance in agricultural damage and as a pest problem. Also studied were cowbirds (Molothrus ater) and starlings (Sturnus vulgaris), since they are commonly found around redwings and grackles and often cause damage or a nuisance problem. The author mentions that although hundreds of materials have been tested to determine what repels the birds, only meager data is known which shows the physiological basis for the repellent action.

263 LING, H.W. 1957. Anesthesia in rabbits. J. Animal Tech. Assoc. Vol. 8, no. 3, pp. 58-60.

This paper presents a good overview on the care and proper administration of anesthetics to rabbits. It tells how to handle emergency situations and the proper doses and procedures for the various drugs.

264 LING, John K., and David G. Nicholls. 1963. Immobilization of elephant seals using succinylcholine chloride. Nature. Vol. 200, no. 4910, pp. 1021-1022.

Elephant seals (Mirounga leonina) were immobilized using a pole extension with a syringe. This method was investigated because physical restraint of the larger animals (up to 3000 kg) was not feasible. Of 42 attempts, 31 seals were immobilized with a reliable dosage being 2 mg/kg. Paralysis usually occurred within 1 minute and lasted from a few seconds up to 45 minutes. No immobilization in some animals may have been due to the needle not penetrating the thick blubber layer. Succinylcholine easily restrained elephant seals of all sizes.

265 LOCKE, David O. 1969. Quinaldine as an anesthetic for brook trout, lake trout, and Atlantic salmon, No. 24. In Investigations in Fish Control. U.S. Dept. of Interior, Bur. Sport Fish. & Wildl. Pp. 1-5.

Quinaldine (2-methylquinoline) was an effective anesthetic for yearling Atlantic and landlocked salmon and brook and lake trout in waters ranging from 10-40 ppm total hardness and temperatures ranging from 36°-40° F and from 47°-59° F. Lake trout were more sensitive than the other species tested. In tests, anesthetization and recovery rates for five concentrations (5, 10, 15, 20, and 25 ppm) at both temperatures (10 ppm) were generally satisfactory for lake trout. A concentration of 15 ppm was satisfactory for marking and general handling of salmon and brook trout. In view of the excellent results, this drug warrants wider use as a fish anesthetic.

266 LOCKIE, J.D., and M.G. Day. 1964. "The use of anesthesia in the handling of stoats and weasels" in Small Animal Anesthesia, Proc. Symp. organized by British Small An. Vet. Assoc. & Univ. Fed. for An. Welfare; London, July, 1963; Oliver Graham-Jones, Ed., The Macmillan Co., New York. Pp. 187-189, illus.

Anesthesia was found to be a valuable aid in handling stoats and weasels in the laboratory or field. Due to these animals being naturally ferocious and excitable, the drug prevented the handler and the animal from becoming injured. After the animal was transferred from a trap or cage into a small collecting box, ether was blown into this box from an ether bottle via a large-bore rubber tube. Light anesthesia was the desired goal, causing the animal to lie inert with obvious breathing. This light anesthesia allowed the animal to be examined, weighed, sexed, and aged. Varying temperatures and individuals made it extremely difficult to administer a standardized dose. Therefore, experience was the main determining factor for proper drug dosages. Over 100 stoats and weasels were anesthetized, with some animals anesthetized more than 40 times.

267 LONGNECKER, David E., Frederick N. Miller, and Patrick D. Harris. 1974. Small artery and vein response to ketamine HCl in the bat wing. Anesth. and Analg. Vol. 53, no. 1, pp. 64-68.

The subcutaneous tissues in the wing of the bat (Myotis species) were given intramuscular injections of ketamine. The purpose was to evaluate the effects of this drug on mean arterial

pressure, heart rate, small artery (30-65 micra) and vein (70-130 micra) diameters. The smallest drug dose which regularly produced anesthesia for 20-30 minutes was 120 mg/kg. This drug dose caused tachycardia and small artery dilation, while there was no change in small vein diameters or blood pressure in 7 bats. Subanesthetic doses of ketamine (40 mg/kg) were given to 5 bats and produced tachycardia and no changes in arterial pressure or small artery and vein diameters.

268 LUHNING, Charles W. 1973. Residues of MS-222, benzocaine, and their metabolites in striped bass following anesthesia, No. 52. In Investigations in Fish Control. U.S. Dept. of Interior, Bur. Sport Fish. & Wildl. Pp. 1-11.

Striped bass (Morone saxatilis), anesthetized in a 100 mg/liter solution of MS-222 at 17.5° C, contained an average of 57.9 mg/g of MS-222 and 23.3 mg/g of *m*-aminobenzoic acid residues in the muscle tissue immediately after a 30-minute exposure to the drug (0-hour withdrawal samples). After this tissue was homogenized and stored in refrigerator for 1 week at 1.7° C, residues were 100% *m*-aminobenzoic acid. Fish anesthetized with benozocaine and treated in like manner still contained residues of benzocaine and a small amount of *p*-aminobenzoic acid (3.4%) after storage. The ester and acid residues of both anesthetics decreased steadily with length of recovery time. The residues were measured by a modified Bratton-Marshall colorimetric method and confirmed by thin-layer chromatography.

269 LUMB, William V. 1963. "Anesthesia of laboratory and zoo animals" in Small Animal Anesthesia, Lea and Febiger, Philadelphia. Pp. 269-310.

Chapter 14 discusses anesthesia of laboratory and zoo animals. A wide variety of animals are discussed including squirrels, mink, ferrets, skunks, falcons, amphibians, reptiles, rabbits and mice. Drug dosages, means of administering the drug, and references to other work previously performed by other scientists are mentioned. The author hopes that this information may serve as a basis for further investigations. The book in its entirety is a comprehensive text on anesthesia.

270 LUMB, W.V. 1963. Small Animal Anesthesia. Lea and Febiger, Philadelphia, Penns., 420 pp.

The Cap-Chur gun and summary of findings of other investigators are discussed, along with species and dosages of several drugs, on pages 300-310, with selected references. Pages 224-226 describe the effects and use of succinylcholine chloride, and page 229 discusses gallamine triethoidide (Flaxedil), a nondepolarizing drug, and the use of edrophonium as an antidote.

271 LUMB, William V. 1965. "The intravenous anesthetic agents" in Experimental An. Anesthesiology, D.C. Sawyer, Ed. USAF School Aerospace Med., Brooks Air Force Base, Texas. Pp. 99-119.

An excellent guide on the intravenous anesthetic agents. Barbiturates, halogenated compounds, chloral and its derivatives, aldehydes, carbamates, steroids, and miscellaneous agents are discussed. Various drugs within these groups are mentioned individually, and in some instances, drug dosages are given for various animals.

272 LUMB, William V., and E. Wynn Jones. 1973. "Anesthesia of laboratory and zoo animals" in Veterinary Anesthesia, Lea and Febiger, Philadelphia. Pp. 427-507, illus.

Chapter 18 is particularly helpful in giving information on anesthetizing a variety of animals, both large and small. Some of the smaller animals include lobsters, fish, snakes, turtles, alligators, crocodiles, penguins, bats, squirrels, prairie dogs, mink, ferret, skunks, weasels, raccoons, and opossums. The chapter mentions previous work performed by other researchers and the different drugs that have been used. Drug dosages, induction times, procedures and other valuable information on this subject area are included. The total text covers the field of animal anesthesiology and is excellent reading material for anyone anesthetizing animals.

273 LUSCHEI, E.S., and J.J. Mehaffey. 1967. Small animal anesthesia with halothane. J. Appl. Physiol. Vol. 22, pp. 595-597.

A device for economically and accurately administering halothane to small animals and preliminary experience with its use on a variety of experimental animals are described.

274 MACKINTOSH, C.G., J.A. MacArthur, T.W.A. Little, and P. Stuart. 1976. The immobilization of the badger (Meles meles). British Vet. J. Vol. 132, p. 609.

The development of a safe method for the tranquillization and immobilization of the badger (Meles meles) is described. Over a period of 8 months, 31 badgers were immobilized on 146 occasions using one of the following agents: etorphine hydrochloride with methotrimeprazine, halothane, ketamine hydrochloride, and Acepromazine. Ketamine hydrochloride was found to be the most satisfactory agent for the safe immobilization of wild badgers in captivity.

275 MANDELKER, Lester. 1970. Anesthesia for parakeets and other birds. J. Am. Vet. Med. Assoc. Vol. 157, no. 8, p. 1081.

Methoxyflurane successfully anesthetized parakeets, canaries, and other birds. A method for anesthetizing a parakeet in its own cage is described that allows the operator a chance to observe the progress of anesthesia. In most cases, a surgical plane of anesthesia is achieved in 5 minutes or less using this method. Unnecessary handling is thus avoided until the bird is anesthetized. Another method is suggested for parrots or other large birds in which some handling is required. Methoxyflurane and oxygen are administered to these larger birds by means of a nose cone, and a plastic bag is also used in the process. Some of the birds successfully anesthetized with this second method include: parakeets, canaries, parrots, macaws, and a goose. The author suggests using a warm air blower after anesthesia to hasten recovery.

276 MANDELKER, Lester. 1971. Practical technics for administering inhalation anesthetics to birds. Vet. Med./SAC. Vol. 66, no. 3, pp. 224-225, illus.

Several simple devices to simplify anesthetization of birds with methoxyflurane are discussed.

277 MAPLETOFT, R.J., and G.J. Futter. 1969. Repeated halothane anesthesia in an American bald eagle. Canadian V. Journal. Vol. 10, no. 10, pp. 274-277.

An immature American bald eagle, weighing 10 lb, was anesthetized by means of halothane, an inhalation anesthetic, on 8 occasions. A halothane concentration of 4% was used to

induce anesthesia and O_2 flow rate ranged from 3-4 liters per minute. Light anesthesia was obtained in 2.5-4 minutes and the recovery was free of excitement. In anesthetizing the bird, it was found extremely important to have a well-fitted endotracheal tube so that the concentration and volume of gases entering the lung could be easily controlled. A discussion concerning the various factors involved in anesthetizing birds with halothane is included.

278 MARKING, Leif L. 1967. Toxicity of MS-222 to selected fishes, No. 12, In Investigations in Fish Control. U.S. Dept. of Interior, Bur. Sport Fish. & Wildl. Pp. 3-10.

Toxicity of MS-222 to rainbow, brown, brook, and lake trout; northern pike; bluegill; largemouth bass; and walleye of various sizes was determined in 15-, 30-, and 60-minute and 24-, 48-, and 96-hour static bioassays at selected temperatures. Twenty-four hour LC_{50} values for the eight species ranged from 33.8-63.0 ppm. Exposures longer than 24 hours had little effect on toxicity. Small fish of a species were more sensitive to the drug than large ones, and trout were more sensitive at warmer temperatures. Safety indexes were calculated on the basis of the brief exposures.

279 MARKING, Leif L. 1969. Toxicity of methylpentynol to selected fishes, No. 30. In Investigations in Fish Control. U.S. Dept. of Interior, Bur. Sport Fish & Wildl. 7 pp.

Methylpentynol was tested in 96-hour bioassays for its toxicity to rainbow, brown, brook, and lake trout; northern pike, channel catfish, bluegills, largemouth bass, and walleyes. The LC_{50}'s range from 660 to 1,890 ppm at 12° C. Channel catfish are the most resistant and lake trout are the most sensitive. Two-inch rainbow, brown, and lake trout are more sensitive to methylpentynol than larger ones in 96-hour exposures. The drug is more toxic to bluegills at 17° than at 12° C. Toxicity was not influenced in different water hardnesses of 10-180 ppm.

280 MARKING, Leif L. 1969. Toxicity of quinaldine to selected fishes, No. 23. In Investigations in Fish Control. U.S. Dept. of Interior, Bur. Sport Fish. & Wildl. Pp. 1-10.

Quinaldine, an anesthetic for fish, is toxic to various sizes of rainbow, brown, brook, and lake trout; northern pike; channel catfish; bluegills; largemouth bass; and walleyes in 15-, 30-, and 60-minute and 3-, 6-, 24-, 48-, and 96-hour static bioassays. Toxic concentrations range from 2.0-25 ppm in standard tests at 12° C in 96 hours. Its toxicity to rainbow trout is significantly greater at higher temperatures, and 96-hour LC_{50}'s range from 13.3 ppm at 8-1.9 ppm at 17° C. In 6-hour exposures, quinaldine is more toxic to fish in hard than in soft water, a condition probably associated with pH. Safety indexes show that shorter exposures to quinaldine are safer to fish, although the concentrations may be greater than required in longer exposures. Recovery from anesthesia is good among survivors in fish exposed to partial-kill concentrations of quinaldine for 96 hours.

281 MARKING, Leif L., and Verdel K. Dawson. 1973. Toxicity of quinaldine sulfate to fish, No. 48. In Investigations in Fish Control, U.S. Dept. of Interior, Bur. Sport Fish. & Wildl. 8 pp.

The acute toxicities of the candidate fish anesthetic, quinaldine sulfate ($QdSO_4$), were determined against selected species of coldwater and warmwater fishes. The LC_{50}'s of $QdSO_4$ ranged from 6.8 mg/liter for largemouth bass to 72.5 mg/liter for carp. In very soft water, $QdSO_4$ solutions are acidic and considerably less toxic than in harder water. This lack of activity is attributed to a decrease in the pH of the test solution which thereby decreases the concentration of the active, un-ionized form of the molecule.

282 MARSBOOM, R., J. Mortelmans, and J. Vercruysse. 1965. R7315- A new hypnotic agent in birds. International Zoo Yearbook. Vol. 5, pp. 200-201.

The hypnotic agent, R7315, has been tested on a wide variety of birds with a high degree of success. The drug is administered intramuscularly, causing the birds to go into a state of deep hypnosis, accompanied by good muscular relaxation. The birds are completely tranquillized within a period of five to ten minutes. This condition can be maintained for a time span of 10-40 minutes, depending on the species of birds. A drug dose level of 5-20 mg/kg in a 1% water solution was used.

283 MARSTON, J.H., G. Rand, and M.C. Chang. 1965. The care, handling and anesthesia of the snowshoe hare (Lepus americanus). Lab. An. Care. Vol. 15, no. 5, pp. 325-328.

While studying hybrid fertilization, 13 adult female snowshoe hares (Lepus americanus) received injections of pentobarbital sodium solution into an ear vein. The rabbits, weighing 1.25-1.68 kg, were administered a mean volume of 30 mg/ml of the anesthetic solution followed by an IV injection of 0.75-2.40 ml. The mean effective dose was determined at 36.8 mg/kg body weight. The surgical anesthesia lasted 20-40 minutes and recovery was generally in 2-3 hours, provided that the hare was left in a quiet, warm cage. No side effects were observed. The methods of management and handling wild snowshoe hares in the laboratory are also discussed.

284 MARTIN, Larry L. 1967. Comparison of methoxymol, alpha-chloralose and two barbiturates for capturing doves. Pittman-Robertson Project #W-41-R, Florida Game & Fresh Water Fish Comm.; Ocala, Fla. Pp. 193-200. (DPL-FWRS 09-7220160).

Four drugs were analyzed and tested for their effectiveness on capturing mourning doves (Zenaidura macroura) in Florida during 1966 and the spring of 1967. The drugs used in the field experiments were: secobarbital sodium, methohexital sodium, methoxymol, and alpha-chloralose. Methoxymol proved to be the most ideal drug tested. Areas were baited with a mixture of wheat and cracked corn, the bait being coated with the various drugs. There were no reported ill effects to the birds due to these drugs. The greatest problems found with anesthetizing the birds was frightening off partially drugged birds from the bait site and losing track of their locations. The 4 drugs are rated and compared, and the best dosages for each are given.

285 MARTIN, N.V., and D.C. Scott. 1959. Use of tricaine methanesulfonate (MS-222) in the transport of live fish without water. Prog. Fish Cult. Vol. 21, no. 4, pp. 183-184.

The Ontario Department of Lands and Forests transported adult lake trout x brook trout (Salvelinus fontinalis) hybrids by anesthetizing the fish with tricaine methanesulfonate (MS-222) and then storing these fish on ice. Through experimentation, it was found that 2-year-old hybrids could not be held in storage as long as the 3- and 5-year-old hybrids. Three water

temperatures (10°; 5°; and 1° C) were used and drug dosages were as follows: 0.5, 0.25, 0.1875, and 0.125. A concentration of 0.5 g/gal proved lethal, while 0.125 g only mildly anesthetized the fish. Generally, good results were obtained with a drug dosage of 0.25 g. Many of the fish transported were in storage for periods of 4 and 4.5 hours. Of the 49 fish transferred, 5 fish died. Three of these 5 fish were in poor condition at the time of packing.

286 MATTINGLY, B.E. 1972. Injectable anesthetic for raptors. Raptor Research. Vol. 6, no. 2, pp. 51-52.

Ketamine hydrochloride has been used as an anesthetic on raptors ranging in size from kestrels to golden eagles without any ill effects. A graph that may easily be used to determine drug dosages out in the field is included in the paper. A bird will be anesthetized for 10-15 minutes using these dosages as determined by the graph. A double dose of the drug can be given initially or the original dose can be repeated after 10-15 minutes if longer anesthetization is necessary. Anesthesia is produced within 5 minutes when ketamine is given intramuscularly. Birds should be hooded while under the effects of this anesthetic.

287 McCORMICK, M.J., and M.A. Ashworth. 1971. Acepromazine and methoxyflurane anesthesia of immature New Zealand white rabbits. Lab. An. Science. Vol. 21, no. 2, pp. 220-223.

Premedication with Acepromazine (1 mg/kg) given 1-1 1/2 hours before inhalation anesthesia with methoxyflurane provided safe, reliable surgical anesthesia for New Zealand white rabbits over a wide range of age (22-151 days) and weight (194-3539 g). Five rabbits in the series of 58 procedures involving methoxyflurane without premedication developed paraplegia due to compression fractures of the lumbar vertebrae. This complication can be attributed to violent motor activity during the prolonged stage of excitement (5-10 minutes) which results from induction with methoxyflurane. This motor response was minimized by the introduction of premedication with Acepromazine.

288 McEARLEN, A.J. 1967. Ethyl *p*-aminobenzoate: An anesthetic for cold-blooded vertebrates. Copeia. No. 1, pp. 239-240.

The drug ethyl *p*-aminobenzoate (benzocaine) possesses many of the same qualities of the widely used drug, tricaine methanesulfonate (MS-222), when used as an anesthetic for cold-blooded vertebrates. The author of this article has used benzocaine on a wide variety of freshwater and marine fish with no ill effects noted. However, benzocaine does lack the solubility of MS-222. A longer contact period is required to induce total immobility in Rana pipiens with benzocaine than ether, yet anesthetization lasts longer with benzocaine.

289 McEARLEN, Andrew J., and Victor S. Kennedy. 1968. Comparison of some anesthetic properties of benzocaine and MS-222. Trans. Amer. Fish. Soc. Vol. 97, no. 4, pp. 496-498.

In the past, the only particular deterrent from using tricaine methanesulfonate (MS-222) as an anesthetic on cold-blooded animals was the high cost of the drug. However, as reported in this article, tricaine methanesulfonate has a "new" drug status due to the possibility of its use on potential human food organisms. A "Statement of Investigator" form is now necessary before the drug may be used. Because of these reasons, a suitable alternative was suggested. A series of experiments were performed comparing benzocaine or ethyl-*p*-aminobenzoate with tricaine methanesulfonate. White perch (Roccus americanus) were used. At low concentrations, benzocaine was faster acting permitting survival, while tricaine methanesulfonate proved less lethal at higher concentrations. The only noted undesirable feature about benzocaine was that it did not dissolve as easily as tricaine methanesulfonate.

290 McFARLAND, W.N. 1959. A study of general anesthesia in teleosts with a discussion of its implications to the transportation of fishes. Doctoral Dissertation. Davis: Univ. of Calif. In Index to American Doctoral Dissertations, 1958-1959. Ann Arbor, Mich.; University Microfilms, Inc. P. 163.

291 McFARLAND, William N. 1959. A study of the effects of anesthetics on the behavior and physiology of fishes. Pub. Inst. Marine Sci. Univ. Texas, Vol. 6, pp. 23-55.

The anesthetic effects of 21 chemicals were tested on the teleosts, Fundulus parvipinnis, Girella nigricans, and Paralabrax clathratus. Some of the chemicals tested (ethyl alcohol, tertiary butyl alcohol, methylparafynol, chloral

hydrate, chlorabutanol, sodium amytal, barbital, phenobarbital, tricaine methanesulfonate, urethane, Meprobamate, chlorpromazine, and magnesium sulfate) induced similar behavioral patterns in the species tested, while 6 (morphine sulfate, reserpine, azacyclonal, iodoacetate, sodium cyanide, and sodium bromide) had no visible effects or were toxic. In the behavioral pattern 4 major stages were observed: (1) sedation; (2) loss of equilibrium; (3) loss of reflex activity; and (4) medullary collapse. The anesthetic sequence observed for fishes is similar to that described for higher vertebrates. Functions such as opercular rate, pectoral fin rate, cardiac rate, and metabolic rate were related to the various stages of anesthesia. It is suggested that measurements of metabolism of fishes in mild anesthesia (sedation) are reliable estimates of basal metabolic rates. The metabolic costs of maintaining equilibrium and integration of the organ systems in Fundulus are discussed. It is shown that a given depth of anesthesia can be maintained in fish for periods from 12-24 hours and often to 48 hours by carefully controlling the concentration of anesthetics dissolved in the medium. Variables, such as temperature, acidity, ionic constitution of the medium, and the size of fish affect the rate of induction and the depth of anesthesia.

292 McFARLAND, William N. 1960. The use of anesthetics for the handling and the transport of fishes. Calif. Fish & Game. Vol. 46, no. 4, pp. 407-431.

The use of anesthetics in fishery work may be broken down into 2 basic divisions: (1) operative procedures, and (2) transport procedures. Each of these 2 topics is discussed in some detail. Several chemical agents capable of inducing anesthesia in fish were studied. Drug recommendations for deep anesthesia (immobility) included using MS-222, tertiary amyl alcohol, and methylparafynol. For transporting marine and/or freshwater fish, the following anesthetics proved the most effective of those tested: tertiary amyl alcohol at approximately 2.0 ml/gal of water, methylparafynol at 1.5-2.0 ml/gal, and chloral hydrate at 3.0-3.5 g/gal. A review of other literature on the subject as well as many graphs and tables are supplied for the reader of this article.

293 McFARLAND, William N. 1969. Anesthesia in fishes. Fed. Proc. Vol. 28, no. 4, pp. 1535-1540.

Many chemical agents, capable of inducing anesthesia in fish, were studied during this investigation. The criteria involved in evaluating these drugs included looking at the depth of anesthesia provided and the species of fish anesthetized. According to these considerations, quinaldine, methyl pentynol, and tricaine methanesulfonate (MS-222) proved to be the most effective. Tricaine methanesulfonate was investigated more thoroughly than the other anesthetics and was noted for its short induction and recovery period. The characteristics, drug dosage requirements, and anesthetic qualities of each of the drugs are described. Suggestions on how to properly administer the anesthetic, how the fish reacts to the drug, and alternative techniques available are mentioned in this paper.

294 McGOVERN, Beulah, and Roberts Rugh. 1944. Efficacy of *m*-amino ethyl benzoate as an anesthetic for amphibian embryos. Proc. Soc. Exper. Biol. Med. Vol. 57, no. 1, pp. 127-130.

This paper discusses aspects of the effects of MS-222 on the fertilization, embryonic development, and the speed of anesthetization at different stages of development of amphibian embryos. When the anesthesia was used in a concentration of 1:3,000 in spring water, no effect was noticed on the motility or the fertilizing power of frog spermatozoa. Exposure to the anesthetic for an hour or less showed no ill effects, while those embryos exposed for longer periods of time showed an increasing number of abnormal embryos. Overall, the anesthetic proved to be very satisfactory.

295 McNEIL, C.W., Robert Gibbons, Paul G. Kinney, and Donald S. Farner. 1958. The use of the urinary bladder of the leopard frog in the demonstrations of peripheral circulation. Turtox News. Vol. 36, no. 8, pp. 170-173.

As an instructional tool, the urinary bladder has been found extremely effective for demonstrating peripheral circulation. According to the frog's size, an injection of 2-6 ml of 5% urethane was given into the dorsal lymph sinus. A description of the other preparations necessary for studying the circulatory system is given.

296 MECH, L.D. 1965. Sodium pentobarbital as an anesthetic for raccoons. J. Mammalogy. Vol. 46, no. 2, pp. 343-344.

In this particular study, 10 raccoons were each injected with a dose of sodium pentobarbital ranging from 6.0 mg/lb to 9.4 mg/lb. When the commercial preparation of Nembutal was used, concentrations of 50 and 60 mg/cc were used. The animals were initially captured in a live trap, weighed, placed into a large can, and anesthetized with ether. The sodium pentobarbital was injected intraperitoneally, usually in the mid-abdominal region. No undesirable aftereffects of the drug were noticed. Doses of 8.0-9.4 mg/lb were considered the most satisfactory with anesthesia resulting in 6-11 minutes. The raccoons were safe to handle for 1/2 to over 3 1/2 hours. Sodium pentobarbital is considered ideal for use in raccoons where light surgery, tagging with radio collars, or other involved procedures are necessary.

297 MEEHAN, William R. and L. Revet. 1962. The effect of tricaine methanesulfonate (MS-222) and/or chilled water on oxygen consumption of sockeye salmon fry. Prog. Fish Cult. Vol. 24, no. 4, pp. 185-187.

Three separate series of laboratory tests were performed on sockeye salmon (Oncorhynchus nerka) to determine their oxygen consumption and apparent condition, using tricaine methanesulfonate (MS-222) and/or cold water to decrease the rate of respiration. The fish survived best in uncrowded conditions in water colder than their original habitat, or in their normal environmental water to which MS-222 had been added in predetermined amounts. No desirable results were obtained with fish that were placed in overcrowded conditions. However, the best survival rate of crowded numbers occurred with colder water and no anesthetic. If fry were placed in water with MS-222 and colder than what the fish were used to, the fish had a high mortality whether conditions were crowded or not. Included is a bar-graph listing the dissolved oxygen at the beginning and end of each test.

298 MEISTER, Alfred L., and Charles F. Ritzi. 1958. Effects of chloretone and MS-222 on eastern brook trout. Prog. Fish Cult. Vol. 20, no. 3, pp. 104-110.

Comparisons were made between the two anesthetics, chloretone (chlorobutanol) (2 propanol- 1,1,1, trichloro- 2 methyl) and MS-222 (tricaine methanesulfonate), to determine their practical field concentrations, the effects with varying water temperatures, and to check anesthetized fish for delayed mortality. Yearling eastern brook trout, Salvelinus fontinalis, ranging in total length from 5.3-10.3 inches, were used. MS-222 was found to have a wider range of practical field concentrations, less inhibitory effect on respiration, and a greater ease and predictability for use in the field than chloretone. The author stresses that the data obtained from this experiment may not apply to other species or to the anesthetics used at higher or lower temperatures.

299 MEYER, Bert J. 1944. Growth and reproduction of the cotton rat, Sigmodon hispidus hispidus, under laboratory conditions. J. Mammalogy. Vol. 25, no. 2, pp. 107-129.

On page 126 of this article, a brief statement is made on anesthetizing cotton rats. Cotton rats (Sigmodon hispidus hispidus) were found very susceptible to ether anesthesia. According to the author, this susceptibility is probably due to their rapid respiratory rate.

300 MITCHELL, Robert T., and Don P. Fankhauser. 1966. Studies on the effectiveness of anesthetics, hypnotics, narcotics, and other chemicals as immobilizing agents for blackbirds and starlings. Unpubl. Annu. Rep. Work Unit F-6.2 (64-65). Patuxent Wildl. Res. Cent., Laurel, MD. 10 pp. (BLM Library).

In March 1965, 6 bait preparations with a soporific drug, DR-7458, were used at a dump near York, Pennsylvania, where an estimated 2,000-3,000 starlings fed daily. Suspensions of the drug in acetone were used in concentrations of 18.5%, 10%, and 5% by weight of drug on bread cubes, and were used on poultry pellets at 15%, 10%, and 5% levels. The bread bait was readily accepted whereas the pellet bait was eaten only when snow was on the ground. During the 9 days of bait exposure, 88 starlings and 6 gulls were collected while anesthetized, and 20 starlings were found dead. Seventy-one of the 88 collected starlings recovered from anesthesia within 2-325 minutes (average 93) after they were collected. Three starlings, one cowbird, and one gull were observed to be affected but were too alert to be collected. No consistent relationship was shown between drug dosage and the length of anesthesia or the degree of bird mortality.

301 MOEN, Tom. 1959. Chloretone crystals dissolved in alcohol for anesthetic. Prog. Fish Cult. Vol. 21, no. 4, p. 191.

A better method for preparing stock solution of chloretone for anesthetizing fish has been suggested by dissolving crystals in alcohol instead of water. About 1 g of chloretone to 4 cc of alcohol was found to be most ideal. This solution may be prepared as easily in the field as in the laboratory. Smaller amounts of alcohol mixed with chloretone can be made up; however, a 1:4 ratio should be maintained as severe precipitation results otherwise. Northern pike have been anesthetized by this method and no adverse effects have been observed.

302 MOLELLO, J.A., and Kiefer Hawkins. 1968. Methoxyflurane anesthesia of laboratory rats. Lab. An. Care. Vol. 18, no. 5, pp. 581-584, illus.

A procedure to induce and maintain anesthesia with methoxyflurane in a multicompartment plastic anesthetic box is described. The method is particularly helpful in handling a group of rats expeditiously, since 10 rats can be maintained under anesthesia at the same time.

303 MORE, Gavin. 1977. Immobilization of marten with sodium pentobarbital. J. Wildl. Manage. Vol. 41, no. 4, pp. 796-798.

In a radiotelemetry study of marten (done near Heart Lake Biological Station, Northwest Territories, Canada, 1974-75), it was necessary to immobilize the animals to change the radio collars. The martens were live-trapped first and then anesthesized with intraperitoneal injections of sodium pentobarbital. Because there was no previous set dose for marten using this drug, initial injections of 20 mg/kg were given followed with injections of 5-10 mg/kg at 10 minute intervals, based on the observed reaction of the animal. It was found that there is a wide individual variation in tolerance to the drug. It is suggested that initial doses of 30-35 mg/kg be given with subsequent injections as needed to avoid overdosing.

304 MORING, John R. 1970. Use of the anesthetic quinaldine for handling Pacific coast intertidal fishes. Trans. Amer. Fish Soc. Vol. 99, no. 4, pp. 802-805.

An advantage of quinaldine is that fish can be left for extended periods in the solution, without ill effects, provided concentrations do not exceed desirable levels. Fish were collected in water temperatures of 8.3-17.2° C, with an average water temperature of 12.2° C. Anesthetizing times varied from 30 seconds or less (Scorpaenichthys marmoratus, rockfish) to 2-4 minutes (other cottids). Recovery times ranged from approximately 5 minutes (cottids, pholids, stichaeids) to 9-14 minutes (Citharichthys stigmaeus, rockfish).

305 MOSBY, Henry S., and Danny E. Cantner. 1956. The use of Avertin in capturing wild turkeys and as an oral-basal anaesthetic for other wild animals. SW Vet. Vol. 9, no. 2, pp. 132-136.

The results of several experiments indicate that many wild animals, including wild turkeys, when orally administered Avertin, required 0.06-0.09 (ml) g/lb of the drug to produce narcosis. Considerable variation exists in the susceptibility of the drug to various animals, yet no fatalities resulted when it was given at the rate of 0.09 g or less per pound of body weight. In addition, Avertin was shown to have a number of advantages over pentobarbital sodium when used on small mammals, reptiles, and birds, as the drug was easier to administer and shock was less likely. Avertin was orally administered to skunks, snakes, rabbits, snapping turtles, domestic and captive wild turkeys, squirrels, cats, chipmunks, starlings, blackbirds, groundhogs and opossums. No fatalities were encountered due to an overdose of Avertin, although one squirrel died, probably from shock. Two tables are included which list the sample reactions of the various forms of wildlife to orally administered Avertin.

306 MOSS, D.D., and D.C. Scott. 1964. Respiratory metabolism of fat and lean channel catfish. Prog. Fish Cult. Vol. 26, no. 1, pp. 16-20.

Channel catfish (Ictalurus punctatus) were anesthetized in a solution of 1 g of tricaine methanesulfonate (MS-222) to 3.8 liters of water. Thereafter, the fish were weighed/measured and placed into a respirometer, recovering in 1-2 minutes. Fat fish had significantly higher oxygen consumption values at 25° C than lean fish of similar weight.

307 MOTT, D.F., J.L. Guarino, E.W. Schafer, Jr., and D.J. Cunningham. 1976. Methiocarb for preventing blackbird damage to sprouting rice. Proc. Vert. Pest Cont. Conf. Vol. 7, pp. 22-25.

Seed rice was treated with 0.25% methiocarb to test its effectiveness as a blackbird repellent in Vermilion Parish, Louisiana, in the spring of 1975. Two replications of 3 treated and 3 untreated plots showed 68% more seedlings in treated plots (2,393) than in untreated plots (1,429). Half as many birds, chiefly redwing blackbirds (Agelaius phoeniceus), were recorded in treated (1.18/min) as in untreated plots (2.39/min).

308 MS-222: Vanished and Banished? 1967. Letter to the editor by William A. Van Bergeick and reply by Fred J. Kingma. Science. Vol. 158, no. 3800, p. 438.

In a letter to the editor, the author airs his views on learning that the Sandoz Pharmaceutical Company has decided to no longer supply the market with tricaine methanesulfonate (MS-222). According to the pharmaceutical company, adequate facilities do not exist on their behalf to test veterinary drugs for New Drug Applications (NDA). The author questions why MS-222 is considered a "new" drug after some 40 years of use by various investigators.

In response to this letter, Fred J. Kingma of the Bureau of Veterinary Medicine-Food and Drug Administration explains the reason for classifying MS-222 as a "new" drug. The drug's proposed use may result in the ingestion of residues by man. And, as Kingma states, no firm has to continue distribution of a product it no longer chooses to market.

309 MUENCH, Bruce. 1958. Quinaldine, a new anesthetic for fish. Prog. Fish Cult. Vol. 20, no. 1, pp. 42-44.

Quinaldine (2-methylquinoline) was found to be a safe and effective drug in anesthetizing fish. Live fish in water were treated with the drug and, when sufficient concentrations of quinaldine were present, a cessation of movement occurred in 45 sec - 6 min. Upon transfer of fish from a solution of quinaldine to fresh water, the fish recovered immediately. The concentration level necessary to achieve an anesthetic level was found to be low. From 5-12 ppm quinaldine was sufficient to produce the desired state of anesthesia in green sunfish, white crappie, yellow bullhead, golden shiner, and

goldfish. The fish may be exposed to the test solutions for relatively long periods - some species were left in the solution for as long as 2 and 3 days. The effectiveness of quinaldine at low temperatures of 50°-54° F is approximately the same at higher temperatures of 74°-79° F.

310 MULDER, J.B., and R.V. Brown. 1972. An anesthetic unit for small laboratory animals. Lab. An. Science. Vol. 22, no. 3, pp. 422-423, illus.

An anesthetic unit was designed for small laboratory animal species. Liquid halothane was used as the anesthetic agent. Circulation of gases with CO_2 removal and conservation of anesthetic agent was accomplished. The portable, self-contained unit provided safe and efficient anesthesia.

311 MUNSON, Edwin S. 1970. Effect of hypothermia on anesthetic requirement in rats. Lab. An. Care. Vol. 20, no. 6, pp. 1109-1113.

The effect of moderate hypothermia (32°-25° C) on cyclopropane and halothane requirements was studied in rats. A rectilinear decrease in anesthetic requirement was observed with decrease in temperature for each agent. Cyclopropane requirement was reduced 33% as body temperature fell 10° C from control (normothermic) values. A decrease in halothane requirement of 63% was seen over the same range of temperature.

312 MURRY, Robert E., and Dan Dennett. 1963. A preliminary report on the use of tranquilizing compounds in handling wildlife. Pittman-Robertson Report, Louisiana, Proj. # W-029-R; Proc. 17th Annu. Conf. SE Assoc. Game & Fish Comm. Pp. 134-139. (DPL-FWRS 17-7520552).

The objectives of this study were: to explore the uses of tranquilizer-like substances in order to prevent mortality caused by shock and mechanical injury, to capture wild animals, to condition wild animals to captivity, and to immobilize animals requiring detailed examinations. The animals used to determine optimum dosage levels were: grey foxes (Urocyon cinereoargenteus), nutria (Myocastor coypus), grey squirrels (Sciurus carolinensis), raccoon (Procyon lotor), deer (Odocoileus virginianus), and domestic turkey. All the animals received Tranimal hypodermically except raccoons, which were dosed with powdered Tranimal. Each of the objectives is discussed separately with results given.

313 MURTON, R.K., A.J. Isaacson, N.J. Westwood. 1965. Capturing columbids at the nest with stupefying baits. J. Wildl. Manage. Vol. 29, no. 3, pp. 647-649.

Wheat baits coated with 3% by weight of alpha-chloralose and placed near occupied and empty nests were eaten by sitting wood pigeons (Columba palumbus). The birds became stupefied and could be collected for examination and marking. When released in the breeding area after recovery, they returned to their nests. This is an efficient technique for capturing such birds, and there is little risk of nest desertion which occurs when nest traps are used.

314 MYERS, Ronald E., and Laurence J. Stettner. 1969. Safe and reliable general anesthesia in birds. Physiol. Behav. Vol. 4, pp. 277-278.

This brief communication reports the use of halothane as a safe and general anesthetic agent for birds. Halothane was tested in 18 giant white carneaux pigeons and 6 bob-white quail without a fatality. The necessary equipment and proper procedures for using halothane in birds are described. Halothane was found excellent in maintaining a surgical depth of anesthesia over long periods of time with a quick postoperative recovery.

315 NAGEL, E.L., P.J. Morgane, and W.L. McFarland. 1964. Anesthesia for the bottlenose dolphin, Tursiops truncatus. Science. Vol. 146, no. 3651, pp. 1591-1593.

Anesthetics can be administered to the bottlenose dolphin, Tursiops truncatus, by means of special ventilating equipment and intubation techniques. Nitrous oxide has been administered successfully on 6 occasions and has produced definite signs of anesthesia. These developments open the possibility of performing major surgery in this species for the first time.

316 NAGEL, E.L., P.J. Morgane, and W.L. McFarland. 1966. Anesthesia for the bottlenose dolphin. Vet. Med./SAC. Vol. 61, no. 3, pp. 229-232.

Experiments of the authors led to a method for anesthetizing the bottlenose dolphin (Tursiops truncatus). Employing special ventilating equipment and intubation technics, they successfully administered nitrous oxide to dolphins on six

occasions, producing definite signs of anesthesia. The procedure proved safe and reliable and opened, for the first time, the possibility of performing major surgery and surgical experimentation on the dolphin.

317 NAGEL, E.L., P.J. Morgane, and W.L. McFarland. 1966. Authors' addendum (January 14, 1966). Vet. Med./SAC. Vol. 61, no. 3, p. 233.

Through further experimentation, additional information was uncovered on the bottlenose dolphin. It was shown that when the anesthetic agent, nitrous oxide, was supplemented using succinyldicholine, the muscle relaxant, excellent surgical anesthesia was obtained. In addition, it was discovered that the enzyme, plasma cholinesterase, was not found in this animal. Therefore, great care must be taken when succinyldicholine and other agents like it are given. A dose of 1 mg/kg body weight results in periods of muscle relaxation lasting 30-60 minutes in this species.

318 NEMOTO, Carl M. 1957. Experiments with methods for air transport of live fish. Prog. Fish Cult. Vol. 19, no. 4, pp. 147-157.

Many experiments were performed in trying to alleviate problems involved in the successful and efficient transport of live fish. One of the many tests performed was on the use of sodium amytal. Two oxygen consumption rate determinations using sodium amytal and three determinations using Na_2HPO_4 buffer without sodium amytal were made. All these procedures were performed on bluegill fish. A definite reduction in the rate of oxygen consumption through the use of sodium amytal was noted. Through the data obtained, it was also shown that the chemical was less effective in increasing the holding time than in increasing the number of fish which could be held. A table with the data obtained is included.

319 NESBITT, Stephen A. (Undated). Capturing sandhill crane with oral tranquilizers. Pro. Int. Crane Workshop. Vol. 1, pp. 296-298. (BLM Library).

The oral tranquilizer, alpha-chloralose, was used in capturing 104 sandhill cranes (Grus canadensis) between 1971 and 1975. Whole kernel yellow corn was moistened and then coated with the drug. Drug dosages ranged from 0.4 to 0.48 g per 284 cc (cup) of corn. A mortality rate of 5.8 percent occurred

within the birds. Mortality of the drugged cranes was usually due to improper handling and not overdosage. Thirty-four other cranes were captured by use of the recoilless rocket nets. The advantages and disadvantages of each of these capture methods are discussed.

320 NEWCOMB, H. R. 1955. Fate of hatchery trout in the wild. Proc. 35th Annual Conf. Western Assoc. State Game and Fish Comm. Pp. 121-127.

The delayed mortality during the first week after transportation of hatchery trout to the wild was investigated. Sodium amytal, a hypnotic drug, was tested to determine its effectiveness in reducing delayed mortalities. The drug, as used, was ineffective in reducing delayed mortality. The author recommends that more thorough investigations under a wide range of conditions be tried.

321 NOLTING, D. H. 1960. Anesthetizing, icing and transporting large mature trout to a high lake. Colorado Department Game, Fish. Job Completion Report for Project #T-50. 15 pp. (DPL-FWRS 05-7640136).

Due to an overpopulation of brook trout in many lakes, it became necessary to devise a successful method of transporting iced, anesthetized fish in an effort to stock these lakes with predatory-type fish. A total of five different batches of fish were subjected to five different types of treatment and although many variations were tried, the results were not promising enough to actually attempt a field trial in a high lake.

322 NOLTING, D. H. 1961. Planting fish in high lakes by helicopter. Special Purpose Report No. 68, Colorado Game, Fish and Parks Dept. 15 pp. (DPL-FWRS 05-7640143).

In order to increase payloads of fish for airplane plants or other stocking operations where weight is a limiting factor, the author recommends the use of tricaine methanesulfonate (MS-222). A disadvantage of this anesthetic, although not considered serious, is that the fish lose much of their equilibrium while they are under the influence of this drug; and therefore, the recently planted fish are subject to possible predation. However, some swimming motion remains in the fish if a proper concentration has been used, and recovery in fresh water is rapid.

323 NORMANDEAU, Donald A. 1962. Microhematocrit values for some salmonids reared in New Hampshire. Prog. Fish Cult. Vol. 24, no. 4, pp. 172-176.

While obtaining blood to determine microhematocrit values, salmonid fish (landlocked salmon; rainbow, brook, lake and splake trout) were anesthetized with tricaine methanesulfonate (MS-222). The fish were placed in a solution containing 1:10,000 of MS-222 for 1 minute or until the fish was entirely anesthetized.

324 NORRIS, Kenneth S., Frank Brocato, and Frank Calandrino. 1960. A survey of fish transportation methods and equipment. Calif. Fish and Game. Vol. 46, no. 1, pp. 5-33.

Due to the ever increasing need by Fish and Game agencies, commercial bait dealers, public aquarium managers, commercial fishermen, and others to transport live fish, better methods and knowledge are necessary on the subject. A total of 96 state and federal government, private agencies, and individuals were questioned concerning the transport of live fish. A review of this information, primarily being limited to principles and methods, is included within this paper. The various drugs used to anesthetize fish, osmotic problems, equipment, and other necessary information on fish transportation are described.

325 NORTH, D. C. 1975. Narcosis in mustellidae. Vet. Rec. Vol. 96, no. 3, p. 71.

In order to remove a trapped, young adult badger from a garden drain, diethylthiambutene hydrochloride (Themalon, Wellcome) was given at a rate of 3 mg/lb. This dose was dissolved in sterile water and injected intramuscularly. In less than 5 minutes, the badger became quiet and started panting. After a short wait, the badger was easily removed from the drain. An antagonist, nalorphine hydrobromide (Lethidrone, Wellcome), was then injected intravenously and the badger was walking in 3-4 minutes.

326 NORTHWAY, Robert B. 1975. Repair of fractured radius and ulna in a brown bat. Vet. Med. /SAC. Vol. 70, no. 8, p. 952.

A fractured radius and ulna in a brown bat necessitated the surgery and thus the anesthetization of the bat. The bat was anesthetized with a 7.5 mg intramuscular injection of ketamine (Ketaset ® -Bristol). No problems were mentioned using this drug.

327 O'STEEN, W. K., and E. J. Mussaro. 1960. A comparative study of the effects of succinylcholine on vertebrates. Tex. Repts. Biol. and Med. Vol. 18, no. 2, pp. 260-270.

Comparisons were made of the effects of succinylcholine chloride on mice, White Rock chicks, American chameleon, leopard frogs, and common spotted newts. The comparative doses were as follows: mouse, 150 mg/kg; chick, 0.38 mg/kg; lizard, 0.75 mg/kg; frog, 1.50 mg/kg; and newt, 9.0 mg/kg. The results were: mice were relaxed by succinylcholine for less than 10 minutes, chicks responded with spastic paralysis and had a recovery period from 24 minutes to 2 hours, and lizards responded with spastic paralysis also with a recovery period from 103 minutes to 18 hours. Lizards were able to tolerate doses ranging from 3.0-64.0 mg/kg and underwent a short period of overall rigidity for approximately 30 seconds, followed by a longer period of relaxation proportional to the dose. The axial musculature was relaxed as in general anesthesia, while the limb musculature seemed to retain its normal tone. Frogs underwent spastic paralysis of the forelimbs and flaccid paralysis of the hindlimbs. Recovery was within 1.5 to 2 hours. No effects were observed with 1.0 mg/kg and death resulted from 3.0 mg/kg. Newts developed complete spastic paralysis within 5 minutes following injection and recovered within 2 hours. They exhibited a high degree of resistance to succinylcholine chloride and were able to withstand up to 160 mg/kg, when they developed extreme edema.

328 PADDLEFORD, Robert. 1978. "Anesthetic management for birds of prey." In Zoo and Wild Animal Medicine. Murray E. Fowler, Ed. W.B. Saunders Co. Philadelphia. Pp. 244-246.

Raptors are more susceptible to inhalation anesthetics than other animals. Both intravenous and intramuscular anesthetic agents have been used in raptorial birds; however, intramuscular routes are normally chosen. Injectable and inhalation anesthesia, along with drug injection location and the monitoring of anesthesia in raptors, are presented.

329 PANDEYA, N. K., and Henry M. Lemon. 1965. Paraldehyde: An anesthesia for recovery experiments in albino rabbits. Lab. An. Care. Vol. 15, no. 5, pp. 304-306.

The use of paraldehyde as an anesthetic agent in 45 albino rabbits was compared to pentobarbital sodium. In 21 rabbits, intravenous injections of pentobarbital sodium, 30 mg/kg body

weight, was used as anesthesia, either alone (in the case of nonsurgical procedures) or in continuation with ether. The onset of anesthesia after a deep intramuscular or intraperitoneal injection of paraldehyde, 1 ml/kg body weight, was between 20-30 minutes. There were only 2 deaths out of 173 applications of paraldehyde anesthesia, in contrast to 12 deaths out of 68 applications of pentobarbital sodium. Unlike pentobarbital sodium, no increased dosage of paraldehyde was needed to reach light anesthesia following repeated injections, sometimes up to 5 injections within 5 days. The paraldehyde injections had to be deep intramuscular or intraperitoneal. Subcutaneous or superficial injections or the injections of decomposed paraldehyde resulted in ulcers and skin sloughing at the site of injection.

330 PARKER, G. H. 1939. General anesthesia by cooling. Soc. Exper. Biol. and Med. Vol. 42, pp. 186-187.

This paper reports on inducing anesthesia for operative purposes without the use of drugs. Frogs, amphibians, and reptiles may be anesthetized either in cracked ice or in ice and water. This paper mentions experiments that have been performed by other researchers using the cooling technique on lizards, newly born rats, and fresh and saltwater fish.

331 PAYNE, J. M., and Jean Chamings. 1964. "The anesthesia of laboratory rodents" in Small Animal Anesthesia, Proc. Symposium organized by the Universities Federation for Animal Welfare; London, July, 1963; Oliver Graham-Jones, Ed., The Macmillan Company, New York. Pp. 103-108, illus.

The customary anesthesia of laboratory rodents, ether, along with non-inhalation and inhalation drugs are discussed. The non-inhalation anesthetics mentioned include: sodium pentobarbitone, sodium hexabarbitone, tribromoethanol and thiopentone. Each of these non-inhalation drugs is useful but each has disadvantages. The paper also discusses an anesthetic apparatus for mice and rabbits which incorporates a rack of gas cylinders and bubble type bottles attached to an operating table. Very few mortalities have been experienced using this apparatus with anesthetic, and the apparatus allows several animals to be anesthetized at the same time.

332 PEEK, James M. 1966. Chlordiazepoxide and pentobarbital as tranquilizers for cowbirds and coturnix quail. J. Am. Vet. Med. Assoc. Vol. 149, no. 7, pp. 950-952.

The effects of *ad libitum* ingestion of chlordiazepoxide and sodium pentobarbital on penned cowbirds and coturnix quail were compared. The agents were incorporated into feed and offered to individually marked birds. Individual response to each agent appeared to relate more to the quantity of food ingested than to the percentage by weight of agent in the food. Response of both species to chlordiazepoxide was similar at the 15% dose despite weight differences of the birds. Responses were too variable to demonstrate significant differences when sodium pentobarbital at the 10% dose was given to both species. No deaths occurred among birds given chlordiazepoxide, whereas 4 quail and 1 cowbird died from sodium pentobarbital ingestion.

333 PEEK, James M., and Robert T. Mitchell. 1965. Studies on the effectiveness of anesthetics, hypnotics, narcotics, and other chemicals as immobilizing agents for blackbirds and starlings. Unpubl. Annu. Rep. Work Unit F-6.2 (63-64). Patuxent Wildl. Res. Cent., Laurel, MD. 12 pp. (BLM Library).

In laboratory studies with soporifics, DRC-7400 at dosages of 10% and 15% and DRC-7458 at 7 1/2%, 10%, 15%, and 25%, were fed *ad libitum* to penned cowbirds (Molothrus ater). Much overlap occurred among dosage levels in times to anesthesia, recovery, and mortality. The most satisfactory results were obtained from 10-15% DRC-7400 with ethanol as the carrier. In tests on 15 birds with these preparations, 1/3 of them became anesthetized. Mean time to anesthetization was 5 minutes and to recovery 24 minutes. One bird died and two did not accept bait. Baiting studies in the field with unshelled corn, cracked corn, wheat, and oats were conducted in February and March 1964 near York, Pennsylvania. Cracked corn was found to be the most widely accepted bait. However, the bait stations were used very little except when snow cover was complete and temperatures were low. In one test with 4-3/4 percent DRC-7458 in cracked corn, no induction or anesthesia was observed in birds that fed upon it.

334 PETERS, A.R., and J. Coote. 1977. Dystocia in a snake. Vet. Rec. Vol. 100, p. 423.

A snake having difficulty in expelling its eggs was anesthetized with 10 mg ketamine hydrochloride (50 mg/kg Ketalar; Parke-Davis) administered by subcutaneous injection. Since the plane of anesthesia was not considered deep enough after 15 minutes, another 5 mg of ketamine hydrochloride was injected. After surgery was performed, ampicillin (Penbritin; Beechams)

was delivered at the rate of 3.6 mg/kg. Complete recovery from the anesthetic occurred in approximately 24 hours. Ampicillin injections were given daily for 3 days. The snake appeared to have an uneventful recovery.

335 PETERSON, Richard S. 1965. Drugs for handling fur seals. J. Wildl. Manage. Vol. 29, no. 4, pp. 688-693.

Seven different drugs were tested on fur seals (Callorhinus ursinus). Nearly 300 animals, mostly adult males, were injected using projectile syringes aimed at the latissimus dorsi muscle. Central nervous system depressant drugs used were thiopental sodium, phencyclidine, propiopromazine, and insulin. Peripheral nerve inhibitor drugs used were nicotine, succinylcholine, and gallamine. Of the central nervous system drugs, phencyclidine was found effective for field immobilization, but generally this group of drugs produced paralysis that was too long lasting. Succinylcholine proved the most useful of the other drugs, but considerable experience is needed for it to be used effectively.

336 PHILLIPS, Arthur, M., Jr., and Donald R. Brockway. 1954. Effect of starvation, water temperature, and sodium amytal on the metabolic rate of brook trout. Prog. Fish Cult. Vol. 16, no. 2, pp. 65-68.

Experiments were performed to determine the effects of cold water, starvation, and the drug sodium amytal on the metabolism of brook trout. The metabolism of the fish was related to the accumulation of ammonia and the utilization of oxygen by the trout. The use of sodium amytal apparently had no effect on the accumulation of ammonia, although the drug was effective in reducing the metabolic rate when used in combination with the long period of starvation (63 hours). No effect was noted in the drug combination with the shorter starvation period (15 hours).

337 PHILLIPS, H. A. 1968. Striped bass propagation. Dingell-Johnson Report, North Carolina, Proj. #F-016-R-04/WP-07/J-B/PT1. 11 pp. (DPL-FWRS 32-6944621).

Striped bass, because of their known excellence in holding indigenous rough-fish populations in balance, were chosen to be stocked in many of North Carolina's reservoirs. During harvest, transport, and stocking, a high mortality was

experienced among the fingerlings. In an attempt to alleviate this problem, 7 ppm of quinaldine was employed to narcotize the fish in the fish distribution tanks. Unfortunately, the drug did not appear to curtail the mortality rate. Zooplankton and food habit studies were also conducted.

338 PINDAK, F.F, and J.Z. Kendrick. 1969. Simple method for anesthetizing small animals for intranasal inoculations. App. Microbiol. Vol. 17, no. 6, p. 920.

By administration of methoxyflurane, aerosolized with a stream of air or oxygen, groups of animals can be conveniently prepared for intranasal inoculations.

339 PISTEY, Warren R., and James F. Wright. 1961. The immobilization of captive wild animals with succinylcholine. Canad. J. Comp. Med. and Vet. Science. Vol. 25, pp. 59-68. (BLM Library).

The physiology of transmitting nerve impulses is discussed in some detail. By blocking the impulse at either the cerebral cortex, the ganglia, or the myoneural junction, immobilization may be induced. The various drugs that are used to cause these various types of immobilization and in some instances their pharmacology are discussed. Factors altering the action of succinylcholine and the practical aspects in the use of this drug are mentioned.

340 PLEUGER, Carl L. 1950. Gastrotomy in a crocodile - A case report. J. Am. Vet. Med. Assoc., Vol. 117, pp. 297-299.

A full-grown, 11-foot, 300-pound crocodile belonging to the Cincinnati Zoo required an operation after swallowing a pop bottle. As no available reference literature was available at the time on crocodile anesthesia and surgery, the author developed his own restraint, anesthesia, and surgical techniques on alligators. After experimenting with various drugs, it was decided to administer a 30 g oral dose of Nembutal (Abbott Laboratories, Chicago) to the crocodile the day before the surgery to produce slight sedation lasting 24 hours. The next morning, 6 cc of d-tubocurarine chloride was administered intraperitoneally and later that afternoon, 40 cc dose of Nembutal was also administered intraperitoneally. The following morning, the crocodile was completely relaxed and received a 10 cc dose of Nembutal. After the successful operation, the stimulant metrazol (Bilhuber-Knoll Corp.; Orange, N.J.) was administered and no significant depression developed postoperatively as a result.

341 POST, George. 1965. A method of immobilizing fish for collection of blood or for inoculation. Prog. Fish Cult. Vol. 27, no. 1, p. 48, illus.

A trough with a foam rubber lining and notches for rubber bands has been found satisfactory in holding anesthetized fish. Six to fifteen-inch fish may be accommodated in the trough which measures 15 inches long by 4 inches deep. The trough may be constructed out of hard-wood paneling, plastic sheeting, or stainless steel sheeting; the lining, of 0.75-110 inch sheeting. This trough was designed to hold fish while attempting to collect blood by cardiac puncture or for inoculations.

342 PYE, J. D. 1967. Bats. In UFAW (eds.): Handbook on the Care and Management of Laboratory Animals. 3rd Ed. Edinburgh, Livingstone, pp. 491-501.

The general care, breeding, and diseases/parasites of bats are discussed. Anesthesia is also mentioned using the following method: intraperitoneal injection of 1 volume of pentobarbitone sodium (Nembutal) in nine volumes of 10-percent ethyl alcohol given in a dose of 30-50 mg/kg of body weight. Extreme variation exists in response and the drug dosages depend on the animal's general condition. To obtain reliable results, the bat should be wide-awake and active previous to the injection. The body temperature of the animal should be stable before the drug is administered.

343 RAISES, M. B. 1967 Anesthesia of cage birds. Australian Vet. Journal. Vol. 43, no. 12, pp. 593-594.

This short article discusses handling, restraint, and methods of using ether as an anesthetic in birds. A budgerigar was anesthetized by holding the bird in the palm of the hand and slowly spraying ether (0.25-0.5 ml) directly into one nostril from a distance of about 1 inch. Oxygen was allowed to freely enter the other nostril. In practice, a 2 ml syringe fitted with a 26 gauge needle is suitable for parrots and the smaller birds such as canaries, finches, and parakeets. A 1/2 inch length needle is normally used.

344 RAMSDEN, R. O., P. F. Coppin, O. H. Johnston. 1976. Clinical observations on the use of ketamine hydrochloride in wild carnivores. J. Wildl. Disease Vol. 12, no. 2, pp. 221-225.

Ketamine hydrochloride was injected intramuscularly into 171 animals of 5 carnivore species: skunk (Mephitis mephitis), mink (Mustela vison), raccoons (Procyon lotor), foxes (Vulpes vulpes), and coyotes (Canis latrans). The authors found the drug to have a wide safety margin, short induction period, and easy administration. Some undesirable effects of the drug, which were overcome with addition of other drugs, are excessive salivation (overcome with phenathiazine tranquilizers or muscle relaxants) and convulsions (overcome with small doses of barbiturates). Only one death occurred due to aspiration of saliva. Included is data chart recording body weight, dose ketamine hydrochloride, time to immobilization and recovery, procedure performed on animal, and comments.

345 RASWEILER, John J. IV. 1978. "American leaf-nosed bats". In Zoo and Wild Animal Medicine. Murray E. Fowler, Ed. W.B. Saunders Co. Philadelphia. Pp. 500-507.

A solution consisting of 1 volume of Nembutal to 9 volumes of 10% ethanol was injected intraperitoneally to provide a dosage of 30-50 mg/kg body weight. It was found important to only work with fully aroused bats and to maintain their body temperature.

346 RATTI, P. and K. Zeeb. 1972. Practical experience with Rompun in the immobilization of game. Vet. Med. Rev. Vol. 3, no. 4, pp. 226-238, illus.

Although this article primarily discusses the use of Rompun on large animals, some general information is also included that could be applied to small animals. The technical, pharmacological, and specific requirements in immobilizing animals are discussed.

347 RAUSCH, R. 1947. Suggestions for the handling of certain mammals. J. Wildl. Manage. Vol. 11, no. 2, pp. 189.

Successful, effective methods of handling small, wild mammals (i.e., racoons, woodchucks, fox squirrels, skunks, and cottontails) while using pentobarbital sodium solution are discussed. Pentobarbital sodium solution was injected intraperitoneally using a recommended dosage of 1 cc (containing one grain of pentobarbital sodium) per pound of body weight. The methods of capturing the small mammals are also briefly discussed.

348 REDIG, P. T., and G. E. Duke. 1976. Intravenously administered ketamine HCl and Diazepam for anesthesia of raptors. J. Am. Vet. Med. Assoc. Vol. 169, no. 9, pp. 886-888.

Forty raptors of 11 species were given a drug combination of ketamine hydrochloride and Diazepam intramuscularly to induce anesthesia for various surgical procedures. In most instances, the birds were immobilized within 15 seconds and anesthetized within 1 minute. Satisfactory results for diurnal raptors were obtained using a dosage of 30 - 40 mg of ketamine HCl/kg of body weight. Owls were much more susceptible to the anesthetic combination and therefore required greater care. The amount of body fat on the bird was found very important in determining the total amount of anesthetic agent. A chart with the intravenous doses of ketamine HCl and Diazepam that induced satisfactory anesthesia in raptors is included within the paper.

349 RICHMOND, Milo, and Clinton H. Conaway. 1969. Management, breeding, and reproductive performance of the vole, Microtus ochrogaster, in a laboratory colony. Lab. An. Care. Vol. 19, no. 1, pp. 80-87.

Ether and pentobarbital sodium were individually used as anesthetics in the vole (Microtus ochrogaster). The pentobarbital sodium solution was the most satisfactory. Surgical anesthesia was maintained for about 3 hours using a dosage of 0.06 mg/g of body weight administered intraperitoneally. Higher dosages resulted in a high mortality, while lower dosages had little effect. After performing some 200 adrenalectomies, the writer of this article has found that there was a greater survival of postoperative voles when they would shiver violently when the skin was dampened by an alcohol swab. The major portion of the article discusses the management, breeding, and reproduction of the vole.

350 RIDGWAY, Sam H. 1965. Medical care of marine animals. J.Am.Vet.Med. Assoc. Vol. 147, no. 10, pp. 1077-1085.

Drug dosage rates and procedures for using halothane gas with the Pacific white-striped porpoise and the Atlantic bottlenose are discussed. Halothane provided a rapid induction with a quick recovery, and a deep plane of anesthesia for major surgical procedures. Nitrous oxide (80%) gave a fairly even plane of light surgical anesthesia, but in comparison to halothane, induction and recovery were slow. Trifluromeprazine given at a drug dosage of 25 mg/100 kg by injection was found

to be the most effective for obtaining a tranquil state without marked respiratory depression. The paper also reports on parasites, disease problems, and physiology of marine mammals.

351 RIDGWAY, Sam H., and James G. McCormick. 1967. Anesthetization of porpoises for major surgery. Science. Vol. 158, no. 3800, pp. 510-512.

Comparison of 3 porpoises (2 Tursiops truncatus and 1 Lagenorhynchus obliquidens) given nitrous oxide with 18 given halothane, with complete documentation of reflexes and comprehensive physiological monitoring, showed halothane to be a suitable anesthetic for major surgery while nitrous oxide was found to be inadequate. In addition, sodium thiopental administered intravenously was successfully used to facilitate intubation procedures. This development eliminated the need to intubate awake porpoises.

352 RIDGWAY, Sam H., and John G. Simpson. 1969. Anesthesia and restraint for the California sea lion, Zalophus californianus. J. Am. Vet. Med. Assoc. Vol. 155, no. 7, pp. 1059-1063.

A pinniped restraining cage was developed for examination, treatment, or induction of anesthesia. Inhalation anesthesia with halothane was found to be satisfactory because of rapid induction and recovery. Physiologic adaptations to life in the aquatic environment (especially in thermoregulation) appeared to limit the usefulness of barbiturates, phencycladine (Sernyl; Parke, Davis & Company, Detroit, Mich.) and phenothiazine-derived tranquilizers.

353 RODMAN, Duane T. 1963. Anesthetizing and air-transporting young white sturgeons. Prog. Fish Cult. Vol. 25, no. 2, pp. 71-78.

Young white sturgeons (Acipenser transmontanus) required anesthetization during transport to Japan from the Seattle Biological Laboratory of the Bureau of Commercial Fisheries. As the effects of fish tranquilizers upon the sturgeon were not known, MS-222 and tertiary amyl alcohol were tested in this study to determine their effects upon the sturgeon. Concentrations of MS-222 ranging from 1:20,000 ppm-1:60,000 ppm were tested. During the 4-hour initial tests, MS-222 at a concentration of 1:40,000 seemed to produce the degree of anesthetization most closely related to deep sedation and gave better results than tertiary amyl alcohol in the extended

tests. No conclusive results could be drawn from using tertiary amyl alcohol as the data were ambiguous. After the failure of the first shipment of sturgeons to Japan, it was suspected that MS-222 at 1:40,000 was most likely a lethal dose over long periods of time, especially when high temperatures were present. In addition, tests were performed upon the fish using cold as an anesthetic, and successful results were obtained. Trial packing was recommended highly prior to shipping sturgeons, as variations between individual fish were shown in the tests using various concentrations of drugs and cold reactions. Three tables are presented in the report giving the results of the various tests in relationship to exposure time/temperature and/or concentration.

354 ROGERS, John G., Jr. 1974. Responses of caged red-winged blackbirds to two types of repellents. J. Wildl. Manage. Vol. 38, no. 3, pp. 418-423.

The response times of male red-winged blackbirds (Agelaius phoeniceus) to two model repellents, sucrose octaacetate, which acts by possessing a bad taste, and lithium chloride, which produces a conditioned aversion, were compared. Comparisons were made in two-choice tests where the palatability of the alternative food varied from equal to highly offensive but nontoxic. The bad-tasting material was quickly effective with the equal alternative, but was ineffective with the highly offensive alternative. In contrast, the conditioning repellent was effective under all conditions and exhibited a delayed effect with the unpalatable alternative. This delay probably results from the necessity for the intoxicating events to occur and be associated with the food. The response pattern to a candidate repellent (methiocarb) indicated that it acts by producing a conditioned aversion to its intoxicating effects. The data suggest that the most likely candidates for effective repellents will come from those chemicals that are capable of producing conditioned aversions in the target species.

355 RONCALLI, R. 1964. Tranimul data. Personal communication to Richard N. Denney Colo. Game, Fish & Parks Dept., Fort Collins, Colo. Hoffmann-La Roche Inc., Research Div., Nutley, N.J.

Tranimul exerts three primary actions: sedative, muscular relaxant, and anticonvulsant. The drug is characterized by a broad safety margin and has been administered intramuscularly to deer, wild goats, zebra, opossum, cottontails, Ethiopian

ass, skunk, apidae, sea lion, and tiger. The onset of the action is rapid, 7-10 minutes, and duration of the action is from 7-18 hours. An effective dosage is 1.0-2.5 mg/lb for tranquilizing action. Sedative action, lasting more than 15 hours, was elicited with 2.5-5.0 mg/lb. It was antidoted with amphetamine sulfate at 0.5 mg/lb subcutaneously, or sodium benzoate at 5 mg/lb.

356 ROYALL, Willis C., Jr. 1961. Bird repellents for pine seeds in the mid-southern states. Trans. 26th North Am. Wildl. & Natural Resource Conf., March 6-8, 1961. Pp. 234-238.

Several biologists and foresters with the Federal Government and other agencies have reported that blackbirds and meadowlarks (Icteridae), finches (Fringillidae), and mourning doves (Zenaidura macroura) are a major cause of failures in natural and artifical seedings of pine in the mid-south (Louisiana and adjacent states) from autumn until early spring. The problem is gradually being solved by using bird repellents, applied as a powder coating, to the seeds. Success has been particularly good in the use of repellents in direct seeding longleaf, loblolly, and slash pine. Promising results have also been obtained on shortleaf pine. A brief history of recorded trials of using chemicals on tree seeds and crops to repel birds is discussed.

357 RUEDI, D., and J. Voellm. 1976. The blow gun - An anaesthetising instrument for the immobilization of wild animals. Vet. Med. Rev. Vol. 1, pp. 85-90, illus.

The construction and use of the Telinject blowgun and syringe are discussed. Two sizes of blowguns are available in the 100-cm and 200-cm lengths. The short blowgun may be used with a high degree of success at short distances on smaller animals such as birds and rodents. The long gun is normally used on the larger, deer-sized animals with accuracy at 12 to 18 m. A table of animals this gun has been tested on, the distances they were tested at, and the drugs used are included.

358 RYDER-DAVIES, P. 1973. The use of metomidate, an intramuscular narcotic for birds. Vet. Rec. Vol. 92, pp. 507-509.

Twenty-two birds were anesthetized with the drug known as R7315. It is also known as methoxymol and most recently as Metomidate. Metomidate was administered into a pectoral

muscle using a tuberculin syringe. A 10-percent solution was used throughout the testing. In most cases, a dose rate of 5 to 8 mg/kg was found adequate. Another injection could be added if the first was not sufficient. This drug is considered very useful and safe by the author. The effects on birds of a number of other anaesthetic agents are also discussed. A table listing a variety of birds tested, dose rates, results, etc., are included.

359 SAMSON, Fred, Floyd Colip, and Jenanne Patterson. 1957. Procedure for the use of sodium pentobarbital anesthesia in classroom experiments with rats. Trans. Kansas Acad. Science. Vol. 60, pp. 425-428.

Although this article discusses the use of sodium pentobarbital as a useful anesthetic in the teaching laboratory, this literature may also serve a useful purpose elsewhere. The age, weight, sex, site of injection, and concentration in relationship to using the drug on the rat are discussed. Recommendations on the use of sodium pentobarbital are given at the end of the paper.

360 SANDOZ PHARMACEUTICALS. (no date). MS-222 - Sandox, the anesthetic of choice in work with cold-blooded animals. Technical Bulletin. Sandoz Pharmaceuticals, Hanover, N.J. 10 pp.

361 SANDOZ PHARMACEUTICALS (no date). The toxicity of MS-222 to fish and frogs. (Mimeo) Sandoz Pharmaceuticals, Hanover, N.J. 2 pp.

362 SANGER, V. L., and H. R. Smith. 1957. General anesthesia in birds. J. Am. Vet. Med. Assoc. Vol. 131, no. 1, pp. 52-55, illus.

Two anesthetics, Equi-Thesin (Jensen-Salsbery Laboratories) and Combuthal (Abbott Laboratories), were administered intramuscularly to domesticated birds. A determination was made concerning the effects of these drugs on the birds' tissues. Both of the drugs offered a quiet and uneventful recovery and induced anesthesia in approximately the same length of time. In addition, both drugs caused considerable inflammation at the site of injection even though no evidence of inflammation was noticed in the living birds. Recovery was generally satisfactory. In some cases, drug dosages varied according to individual birds.

363 SAVARIE, Peter J. 1976. Pharmacological review of chemicals used for the capture of animals. U.S. Fish & Wildlife Publ., Bldg. 16, Fed. Center, Denver, Colo. Reprint from Proc. 7th Vertebrate Pest Control Conf. (Univ. Calif., Davis). Pp. 178-184.

A review of the literature reveals that over 60 chemicals have been used for the capture of wild animals, but only 30 of the most widely used chemicals are discussed in the present paper. For practical considerations these chemicals can be classified as being either: (1) neuromuscular blocking agents, or (2) central nervous system (CNS) depressants. Some common neuromuscular blocking agents are *d*-tubocurarine, gallamine, succinylcholine, and nicotine. M-99 and its derivatives, phencyclidine, and xylazine are some of the most commonly used CNS depressants. Neuromuscular blocking agents have a relatively rapid onset and short duration of action but they do not possess sedative, analgesic, or anesthetic properties. CNS depressants do produce desirable sedative, analgesic, and anesthetic effects, and frequently a combination of CNS depressants results in more desirable immobilization characteristics.

364 SAVITZ, Jan. 1969. Effect of MS-222 on nitrogen excretion of the bluegill (Lepomis macrochirus). J. Elisha Mitchell Sci. Soc. Vol. 85, no. 4, pp. 150-151; Selected Water Resources Abs. Vol. 4, no. 18, pp. 32.

Because MS-222 (tricaine methanesulfonate) anesthetizes fish, it was also expected to lower their nitrogen excretion rate. Static bioassays were used with pre- and post-treatment water samples being analyzed for nitrogen content. The nitrogen excretion rates for bluegills treated with 0.003% MS-222 for one day were not significantly different from those of untreated controls.

365 SAWYER, Donald C. 1965. "Anesthetic technics of rabbits and mice." In Experimental An. Anesthesiology, D. C. Sawyer, Ed. USAF School Aerospace Med., Brooks Air Force Base, Texas. Pp. 344-349.

The anesthetic recommended for rabbits is thiopental sodium given intravenously at a rate of 25 mg/1 cc. The anesthetic was administered using a 2.5 cc syringe and a 25 gauge needle. The order of preference of anesthetics for rabbits was: thiopental sodium, methoxyflurane, ether, and sodium pento-

barbital (Nembutal). For long-term procedures, thiopental sodium and methoxyflurane have been used in combination form. Indications of anesthetic levels are discussed. This article also included information on anesthesia of mice. The mortality rate of mice using methoxyflurane was less than 5% while using Nembutal intraperitoneally and/or ether by open drop was over 50%. Techniques and methods used for both animals are described.

366 SAZAKI, M., W. Heubach, and J.E. Skinner. 1972. Some preliminary results on the swimming ability and impingement tolerance of young-of-the-year steelhead trout, King salmon, and striped bass. Cal. Anadromous Fisheries Series-13. 34 pp. (DPL-FWRS 04-7440030).

Laboratory tests were performed to determine the swimming ability and impingement tolerance of the young of selected anadromous fish species. In one of the tests, King salmon fish were anesthetized with a 1:25,000 solution of MS-222 to help facilitate measuring the fish. Based on the findings, it was determined that if the fish were measured prior to testing, there was less variability in the results caused by differences in fish size. In addition, the swimming performance of salmon anesthetized 24 hours prior to testing was not greatly different than that of the control fish. The survival following impingement was not affected by the anesthetic.

367 SCHAFER, E.W., Jr. Oral chemical immobilizing agents for capturing birds. Presented at Wildlife Disease Assoc. Symp.; Fort Collins, Co., August 2, 1978. (In press).

During the last three decades, a serious effort has been made by various research groups to devise safe, effective, and practical methods of capturing wild birds with immobilizing chemicals. To date, these goals have not been realized. There are many reasons why avian immobilizing chemicals have not been developed and widely used. A major difficulty has been the large variation among the responses of the target bird species. No chemicals are registered in the United States for operational use in capturing wild birds, and no registrations are contemplated for the near future. A tabular listing of experimental avian immobilizing agents and of the species which have been tested is presented.

368 SCHAFER, Edward W., Jr., and Ronald B. Brunton. 1971. Chemicals as bird repellents: Two promising agents. J. Wildl. Manage. Vol. 35, no. 3, pp. 569-572.

Of 724 chemicals screened as repellents for red-winged blackbirds (Agelaius phoeniceus), only 6 satisfied criteria for high repellency and low toxicity. Of these, 4-methylthio-3, 5-xylyl *N*-methylcarbamate (methiocarb) and 2-methyl-α, α-diphenyl-1-pyrrolidinebutyramide (DRC 3324) were consistently effective against house sparrows (Passer domesticus), grackles (Quiscalus quiscula), pheasants (Phasianus colchicus), tricolored blackbirds (Agelaius tricolor), brown-headed cowbirds (Molothrus ater), and California quail (Lophortyx californicus).

369 SCHAFER, Edward W., Jr., and Donald J. Cunningham. 1972. An evaluation of 148 compounds as avian immobilizing agents. U.S. Dept. of Interior, Bur. Fish. & Wildl., Special Scientific Report-Wildlife No. 150. 30 pp.

From 1961 to 1969, some 148 compounds were tested for immobilization of red-winged blackbirds (Agelaius phoeniceus) and starlings (Sturnus vulgaris). Of these, 25 showed enough promise to warrant advanced testing on seven additional species of wild birds: the common grackle (Quiscalus quiscula), common pigeon (Columba livia), house finch (Carpodius mexicanus), house sparrow (Passer domesticus), mallard duck (Anas platyrhynchos), ring-necked pheasant (Phasianus colchicus), and yellow-headed blackbird (Xanthocephalus xanthocephalus). Although no single compound was best suited for immobilizing all of the nine species tested, Banol (6-chloro-3, 5-xylyl *N*-methylcarbamate) Dowco, 161 (O-ethyl, O-2, 4-dichlorophenyl phosphoroamidate), methomidate [methyl ester of imidazole-5-carboxylic acid; 1-(α-methylbenzyl)], and Metomidate HCL possessed exceptional activity on three or more of the species tested. Of the species tested, redwings and house finches were the most sensitive to immobilizing agents, and pheasants the least.

370 SCHAFER, E.W., R.I. Starr, D.J. Cunningham, and T.J. Decino. 1967. Substituted phenyl *N*-methylcarbamates as temporary immobilizing agents for birds. J. Agr. Food Chem. Vol. 15, no. 2, pp. 287-289.

The temporary immobilization activity and acute oral toxicity of 22 substituted phenyl *N*-methylcarbamates were determined on red-winged blackbirds (Agelaius phoeniceus) and starlings

(Sturnus vulgaris). Twelve compounds immobilized redwings and eight immobilized starlings (Sturnus vulgaris). Three were exceptionally effective: *O*-(2-propynyloxy) phenyl *N*-methylcarbamate on redwings, 6-chloro-3, 4-xylyl *N*-methylcarbamate on starlings, and 4-(methylthio)-3, 5-xylyl *N*-methylcarbamate on both redwings and starlings. Detailed, technical, and chemical structural effects are also discussed.

371 SCHAFER, E.W., Jr., R.B. Brunton, N.F. Lockyer, and D.J. Cunningham. 1975. The chronic toxicity of methiocarb to grackles, doves, and quail and reproductive effects in quail. Bull. Environ. Contam. Toxicol. Vol. 14, no. 6, pp. 641-647

Methiocarb (4-methylthio-3, 5-xylyl *N*-methylcarbamate, Mesurol, Bay 37344), a bird repellent, was fed in concentrations of 100-1,000 ppm to common grackles (Quiscalus quiscula), mourning doves (Zenaida macroura), and breeding pairs of coturnix quail (Coturnix coturnix) to investigate the possibility of cumulative intoxication. Although aversion to treated diets was readily apparent in most of the tests, the 28- to 30-day median lethal concentration (LC_{50}) was determined to be >100 ppm for grackles, 630 ppm (95% confidence limits, 480-830 ppm) for doves, and >1,000 ppm for coturnix quail. Methiocarb appeared to be noncumulative when measured by an index of chronicity. Birds consumed several LD_{50} doses during a day's feeding, and when deaths occurred, they appeared to be due to acute intoxication. Egg production and live chick production were not affected in coturnix fed 100 ppm but were reduced at 316 and 1,000 ppm.

372 SCHAFER, E.W., Jr., R.B. Brunton, and N.F. Lockyer. 1977. Learned aversion in wild birds: A method for testing comparative acute repellency. Test Methods for Vertebrate Pest Control and Management Materials, ASTM STP 625, W.B. Jackson and R.E. Marsh, Eds., American Society for Testing and Materials, pp. 186-194.

A method was developed to measure the comparative acute learned aversion of a number of wild bird species to repellent chemicals. It was shown that both the innate acute response and the intensity and duration of the learned response of birds to repellents vary among species. Two repellents, methiocarb and thiram, were tested. Methiocarb [3,5-dimethyl-4-(methylthio)phenol methylcarbamate, Bay 37344] produced the stronger and more lasting response in most species; thiram (tetramethyl thiuram disulfide, TMTD) was much more variable in its acute effects, and the intensity and duration of the

learned response tended to be weaker and shorter. Factors relating to improving the test methodology presented are discussed, especially with regard to the species tested.

373 SCHALLOCK, E.W. 1966. Investigations of the Tanana river and Tangle lakes fisheries: Migratory and population study. Dingell-Johnson Report, Alaska, Proj. # F-005-R-07/WP-16/J-B. Pp. 231-248. (DPL-FWRS 506940789)

This research conducted by the State of Alaska investigates the migratory patterns and populations of fish. Due to the need to tag the fish, anesthetization became necessary. A discussion on the amount of tricaine methanesulfonate (MS-222) used in relationship to water temperature, along with capturing and tagging techniques, growth, and spawning are included within this report.

374 SCHIFFMAN, Robert H. 1959. Method for repeated sampling of trout blood. Prog. Fish Cult. Vol. 21, no. 4, pp. 151-153.

Fish were anesthetized lightly (drug amounts not given) with tricaine methanesulfonate (MS-222). The fish were anesthetized in order to draw blood from the dorsal aorta. All fish used in the tests survived.

375 SCHOETTGER, Richard A. 1967. Annotated bibliography on MS-222, No. 16. In Investigations in Fish Control, U.S. Dept. of Interior, Bur. Sport Fish. & Wildl. Pp. 3-13.

This bibliography contains 86 selected references on uses of MS-222 on cold-blooded animals including fish and amphibians. Most of the references are annotated.

376 SCHOETTGER, Richard A., and Arnold M. Julin. 1967. Efficacy of MS-222 as an anesthetic on four salmonids, No. 13. In Investigations in Fish Control. U.S. Dept. of Interior, Bur. Sport Fish. & Wild. Pp. 3-15.

MS-222 was tested for its efficacy as an anesthetic for rainbow, brown, brook, and lake trout. Eighty to 135 ppm of MS-222 anesthetized fish within 3 minutes at 7° to 17° C. The fish could be exposed for a total time of 4-12 minutes. Fifty to 60 ppm induced a moderate rate of anesthesia which could be

maintained for approximately 30 minutes. Sedation was produced within 15 minutes and maintained for 5-6 hours at 15 to 30 ppm. The efficacy of sedation concentrations appeared to decrease with time at 17° C. Lake trout required larger doses than the other salmonids for complete anesthesia but tolerated only short exposures. There was no relation between size of fish and efficacy of MS-222. Smaller fish occasionally had shorter exposure times. The drug was equally effective at pH values of 5.0, 7.0, and 8.5. Anesthetic solutions with a total hardness of 10 ppm were less effective in anesthetizing rainbow trout than those containing 35 and 180 ppm. Individuals which were anesthetized in soft water recovered sooner.

377 SCHOETTGER, Richard A., and Arnold M. Julin. 1969. Efficacy of quinaldine as an anesthetic for seven species of fish, No. 22. In Investigations of Fish Control. U.S. Dept. of Interior, Bur. Sport Fish. & Wildl. Pp. 1-10.

Quinaldine was tested as an anesthetic for rainbow, brown, brook, and lake trout; channel catfish; bluegill; and largemouth bass. In general, 15-70 ppm of the drug induce total loss of equilibrium in fish within two minutes. Efficacy is influenced by acid pH and, for some species, by temperature, but not by water hardness, age of quinaldine solutions, or repeated exposures of fish to quinaldine. Assets include rapid action and prolonged maintenance of anesthesia, but anesthetized fish retain a degree of reflex responsiveness which may interfere with stripping, delicate surgical operations, and blood collection. The drug is harmless to fertilized rainbow trout eggs at concentrations and exposure times normally encountered in spawning operations.

378 SCHOETTGER, Richard A., and Erwin W. Steucke, Jr. 1970. Quinaldine and MS-222 as spawning aids for northern pike, muskellunge, and walleyes. Prog. Fish Cult. Vol. 32, no. 4, pp. 199-201.

In March and April of 1967 and 1968 studies were conducted during spawning periods on northern pike (Esox lucius) and walleyes (Stizostedion vitreum), which were trapped from the wild by the National Fish Hatcheries at Genoa, Wisconsin, and Valley City, North Dakota. Muskellunge (E. masquinongy) were also tested. Concentrations of quinaldine within the range of 10-20 ppm anesthetized northern pike, muskellunge, and walleyes, while concentrations of 100-150 ppm of MS-222 were necessary to anesthetize those same species. Fish tolerated relatively long exposures of quinaldine, but the drug failed

to block all reflex activity. MS-222 blocked reflex activity well, but fish did not tolerate as much exposure to this drug as with the use of quinaldine.

379 SCHOETTGER, Richard A., and Erwin W. Steucke, Jr. 1970. Synergic mixtures of MS-222 and quinaldine as anesthetics for rainbow trout and northern pike. Prog. Fish Cult. Vol. 32, no. 4, pp. 202-205.

The objective of this study was to determine whether MS-222 and quinaldine could be used together to achieve safer and more effective anesthesia of fish than by using the drugs by themselves. The rainbow trout (Salmo gairdneri) used in this work were obtained from a fish hatchery, while the northern pike (Esox lucius) were trapped in the wild. All the fish tested were of varied length and weight. No real determination was made on the efficacy of mixtures of MS-222 and quinaldine relative to fish size. Rainbow trout were less resistant than northern pike to mixtures of MS-222 and quinaldine. However, in most cases, northern pike required more time for recovery in fresh water than did the trout. Limited trials with longnose gar (Lepisosteus osseus), goldfish (Carassius auratus), and black bullheads (Ictalurus melas) indicated that this drug mixture may be effective in other species of fish. The reflex movement in goldfish and bullheads was blocked in 5 minutes by 60 ppm of MS-222 and 20 ppm of quinaldine, whereas it took up to 11 minutes to anesthetize gar. The drug mixture was found highly successful. Not only was the drug mixture less expensive than using MS-222 singly, but the mixture appeared safer than use of MS-222 alone. The fish anesthetized with the mixture can be exposed up to six times longer; thus, more fish can be anesthetized at one time. The authors emphasize that water quality, temperature, size, and species of fish may require changes in mixture ratio and concentrations. Two charts listing the data of the efficacy of MS-222 and quinaldine mixtures as anesthetics in rainbow trout and northern pike at 12° and 17° C are given.

380 SCHOETTGER, Richard A., Charles R. Walker, Leif L. Marking, and Arnold M. Julin. 1967. MS-222 as an anesthetic for channel catfish: Its toxicity, efficacy, and muscle residues, No. 17. In Investigations in Fish Control, U.S. Dept. of Interior, Bur. Sport Fish. & Wild. Pp. 3-14.

MS-222 was tested as an anesthetic on channel catfish. Its acute toxicity is approximately 50-65 ppm over periods of 24-96 hours. Anesthesia is induced within 2 minutes by concentrations above 100-140 ppm, and within 15 minutes by 70 ppm. Concentrations of 20-40 ppm maintain sedation for 6 hours. Residues of MS-222 occur in muscles of anesthetized catfish but decrease about 90 to 95 percent at 1 hour of withdrawal from the drug. Nine to 24 hours after withdrawal the residues decline to within the statistical variations of the background aromatic amines. The influences of duration of exposure, size of fish, temperature, and water quality on toxicity, efficacy, and residues are discussed.

381 SCHWARTZ, Frank J. 1966. Use of MS-222 in anesthetizing and transporting the sand shrimp. Prog. Fish Cult. Vol. 28, no. 4, pp. 232-234.

MS-222 (tricaine methanesulfonate) was used successfully as an anesthetic in bulk handling of sand shrimp (Crangon septemspinosa). These studies and observations on the sand shrimp resulted from the need to handle, mass pack, and transport these specimens on a 7-hr flight prior to their introduction into three alkaline and saline lakes in North Dakota. The 3,240 shrimp were divided into 4 lots; each lot was placed into a plastic bag and then into a styrofoam box. Each bag held 8,000 cc of seawater to which 2 g of MS-222 had been added. Eighty percent of the shrimp survived and recovered from the shipment, 7 hours of tranquilizers, and varying temperature.

382 SEAL, Ulysses S., and Albert W. Erickson. 1969. Immobilization of carnivora and other mammals with phencyclidine and promazine. Fed. Proc. Vol. 28, no. 4, pp. 1410-1419.

Promazine hydrochloride and phencyclidine were used in combination form and applied 957 times to 530 animals of 127 species of mammals over a 2-year period. This drug combination was used in both field and zoo situations. The families immobilized with this drug combination included: Ursidae, Canidae, Procyonidae (raccoons), Mustelidae (skunks), Felidae, Hyaenidae, Viverridae, Pinnipedia, Cervidae, and Bovidae. Some of the miscellaneous mammals also immobilized were: squirrels, woodchucks, beavers, porcupines, aardvarks, opossums, and giant anteaters. Many tables are included giving information on the animals anesthetized, the number of trials tried, dosage ranges, and responses to the drug combination.

383 SEAL, Ulysses S., Albert W. Erickson, and Joseph G. Mayo. 1970. Drug immobilization of the carnivora. International Zoo Yearbook. Vol. 10, pp. 157-170.

Originally, phencyclidine hydrochloride (Sernylan) was used alone for the immobilization of 66 zoo animals representing 12 species of mammals. Later, promazine hydrochloride (Sparine) was used in combination form with phencyclidine hydrochloride to immobilize 1,075 animals of 156 species of mammals. Only 2 animals were lost as a result of anesthesia. The family Mustelidae (which includes minks, weasels, stoats, ferrets, martens, otters, badgers, skunks, and others) were anesthetized very effectively using 1 mg/kg phencyclidine and 1 mg/kg of promazine. Some of the other small animals also anesthetized with this drug combination were: squirrels, woodchucks, porcupines, aardvarks, and opossums. Additional studies were done on 94 pregnant animals of 26 species. No foetal or maternal losses were caused as a result of these drugs. The paper also reports on many large animal species.

384 SECORD, A.C. 1958. Fractures in birds repaired with the Jonos Splint. Vet. Med. Vol. 53, Pg. 655-656.

385 SEHDEV, H.S., J.R. McBride, and U.H. Fagerlund. 1963. 2-phenoxyethanol as a general anesthetic for sockeye salmon. J. Fish. Res. Bd. Canada. Vol. 20, no. 6, pp. 1435-1440.

The dose-response relationship of 2-phenoxyethanol, as a general anesthetic, in adult sockeye salmon (Oncorhynchus nerka) has been investigated. At 11° C the effective dose (ED_{50}) and lethal dose (LD_{50}) were approximately 43 and 130 ml/100 imperial gal, respectively. The therapeutic ratio (LD_{50}/ED_{50}) was more than 3, indicating a good margin of safety. At a lowered aquarium temperature of 4° C, the anesthetic effects of 2-phenoxyethanol were potentiated. ED_{50} and LD_{50} at this temperature were approximately 25 and 130 ml/100 gal of water, respectively. The therapeutic ratio was more than 5, indicating that the margin of safety was increased by the reduction in temperature.

386 SEIDENSTRICKER, John C., IV, and Harry V. Reynolds, III. 1969. Preliminary studies on the use of a general anesthetic in falconiform birds. J. Am. Vet. Med. Assoc. Vol. 155, no. 7, pp. 1044-1045.

A preparation containing pentobarbital sodium magnesium sulfate and chloral hydrate was administered intramuscularly to 18 raptors representing 6 species: 1 sparrow hawk (Falco sparverius), 1 prairie falcon (Falco mexicanus), 1 marsh hawk (Circus cyaneus), 2 Swainson's hawks (Buteo swainsoni), 5 red-tailed hawks (Buteo jamaicensis), and 8 golden eagles (Aquila chrysaetos). Out of a total 44 experimental injections, surgical planes of anesthesia were achieved 24 times in 5 species. Minimum dosage of anesthetic necessary to consistently produce a surgical plane of anesthesia was determined for the prairie falcon, red-tailed hawk, Swainson's hawk, and marsh hawk. Varied results were obtained with golden eagles. Insufficient trials were performed to establish the correct dosage for sparrow hawks.

387 SEKIZAWA, Yasuharu, Takahiko Kikuchi, and Akira Suzuki (Res. Labs., Meiji Seika Kaisha, Ltd., Morooka-cho, Kohoku-ku, Yokohama, Japan). 1971. Electrophysiological surveys on the anesthetic properties of 2-amino-4-phenylthiazole upon carp (Cyprinus carpio). Jap. J. Ichthyol. Vol. 18, no. 3, pp. 128-138. (In Japanese with English abs.).

Surveys were performed regarding the electrophysiological characteristics of inhalation anesthesia with 2-amino-4-phenylthiazole upon carp (Cyprinus carpio L.). Major centrifugal nerve-muscle systems (such as spinal nerve with levator muscle of anal or pectoral fin and cerebral nerve with mandibular muscle) and major sensory organs with centripetal nerve systems (such as olfactory organ with its nerve, eye with optic nerve, labyrinth with the VIII nerve and lateral organs with the X nerve) were observed to be still electrophysiologically active under the anesthetized condition. Any detrimental effect upon heart beating under the anesthetized condition was not observed so far with the electrocardiograms directly derived from the exposed hearts. Any depressive effect on the action potential of an isolated preparation of postesophageal ample of the alimentary canal was not observed by the direct application of the compound in Masugi's solution. The electroretinogram under the anesthetized condition was still normal. The electrical response of optic lobe of midbrain was also still normal under the anesthetized condition when an eye in the opposite side was irradiated by incandescent lamp. Temporary depressive effects observed in the extent of the present investigation were summarized as follows: (1) Although the inhibitory effect on the function of the olfactory system (from olfactory organ to its nerve via olfactory bulb) was not observed, the electrical response of

forebrain seemed to be weakened under anesthetized condition. This was reinforced by the direct application of the compound into forebrain by fine glass capillary. The direct application upon the isolated axon of olfactory nerve did not give the depressive effects. (2) Although the inhibitory effect on the acousticolateral system was not observed, the induced action potentials around the frontal side of medulla oblongata (near pons) seemed to be weakened under the anesthetized condition when spinal cord was electrically stimulated. The same depressive effect was observed only by the direct application of the compound into inferior lobe of interbrain with fine glass capillary. (3) Spontaneous 16-18 Hz wave derived from the center part of cerebellum rapidly disappeared and reappeared in the anesthesia and its recovering process. This was also reinforced by the direct application into cerebellum. (4) Under critical condition at inhalation anesthesia such as in the application of high concentration and/or a long-time run, autonomic characteristic of respiratory center seemed to be disordered, and finally a paralysis in the center caused death. The direct application of the compound into deep position of pons caused a seizure type discharge similar to the case of the critical treatment under inhalation anesthesia. Under the anesthesia in an appropriate grade, the oxygen uptake due to respiration was decreased to one fourth of that under vigorous swimming condition and was approximately equal to the oxygen uptake under the stationary condition. The above experimental evidences seemed to imply that the characteristic of inhalation anesthesia caused by 2-amino-4-phenylthiazole upon carp should be attributed to its centrally acting mechanism.

388 SEUBERT, John L., J.B. Dewitt, W.L. Reichel, D.P. Fankhauser, W.T. Van Velzen, W. Libby, R.M. Prouty, J.M. Peek, and R.T. Mitchell. 1970. Effectiveness of chemicals for immobilizing herring gulls. Final Report under Work Unit P-F-6.1, U.S. Dept. of Interior, Bur. Sport Fish. & Wildl., Patuxent Wildlife Research Center, Laurel, Maryland. 6 pp.

Among a series of drugs tested in the laboratory in 1961, tribromoethanol (Avertin) was the most favorable candidate for field testing. Oral dosages up to 200 mg/kg rendered gulls unconscious from 1-8 minutes. One inch squares of sliced bread, coated with corn syrup or fish oil to which the powdered drug adhered, proved to be the most acceptable bait preparations for gulls. Twenty five of 71 candidate drugs, including tribromoethanol and sodium pentobarbital (Nembutal), in bait with dosages up to 200 mg/kg, anesthetized gulls in

the laboratory within 30 minutes of bait acceptance. Tribromoethanol-treated baits were tested on ring-billed gulls at a dump in the District of Columbia and on herring gulls at three locations in New Hampshire. None of approximately 125 ringbills at the D.C. site fed on the bait. In four of nine baitings in New Hampshire, about 42 percent of the baited herring gulls were captured. Sodium pentobarbital-treated baits were field-tested on herring gulls in New England with much less favorable results.

389 SHERRARD, EMIL. 1966. Anesthesia of rabbits. Vet. Rec. Vol. 78, no. 7, pp. 253-254.

During a two-year span, 123 rabbits of varying strain, size, age and sex were anesthetized with halothane. Most of the animals were anesthetized a minimum of 2 times with some receiving the drug on 3 or 4 occasions. The duration of anesthesia lasted anywhere from 10 minutes to over 3 hours, and only 4 rabbits were lost to the anesthesia. The induction box and the apparatus/methods used are described in this paper.

390 SHRYER, Jeph. 1971. A new device for remote injection of liquid drugs. J. Wild. Manage. Vol. 35, no. 1, pp. 180-181.

Due to the high cost of commercially manufactured guns that project syringes, an inexpensive substitute has been devised. This substitute may be fired from .22-caliber firearms with an exposed breech to deliver liquid drugs to animals from distances up to 25 yards. Due to the dart's smaller size and reduced velocity, the dart does not strike with the force of a commercially manufactured dart. Because of this, the dart is excellent for using on small animals. The projectile is capable of successfully injecting .25 cc. A description and diagram of the dart are given.

391 SILLS, J.B., and J.L. Allen. 1971. The influence of pH on the efficacy and residues of quinaldine. Trans. Am. Fish Soc. Vol. 100, no. 3, pp. 544-545.

Quinaldine, an anesthetic for fish, loses its effectiveness in solutions having pH values less than 6. Measured quantities of un-ionized quinaldine in solution compared favorably with calculated values of selected pH's. Quinaldine residues in largemouth bass (Micropterus salmoides) anesthetized at

various pH's verify that only the un-ionized portion in solution enters the fish. Quinaldine residues in fish and un-ionized quinaldine in solution were measured by gas chromatography.

392 SILLS, Joe B., and Paul D. Harman. 1971. Efficacy and residues of quinaldine sulfate, an anesthetic for striped bass (Roccus saxatilis). Proc. 24th Ann. Conf. SE Assoc. Game & Fish Comm., Sept. 27-30, 1970, pp. 546-549.

Striped bass (Roccus saxatilis) were exposed to solutions of quinaldine sulfate containing 10, 25, 40, and 55 ppm of quinaldine. Fish were effectively anesthetized at concentrations of 25-55 ppm. Residue levels in muscle tissue of fish exposed to 40 ppm of quinaldine at 4° C for 10 minutes reached 2.60 ppm but were essentially gone after 24 hours of recovery in fresh water.

393 SILLS, Joe B., John L. Allen, Paul D. Harman, and Charles W. Luhning. 1973. Residue of quinaldine in ten species of fish following anesthesia with quinaldine sulfate, No. 50. In Investigations in Fish Control. U.S. Dept. of Interior, Bur. Sport Fish & Wildl. 9 pp.

The concentration and persistence of residues of the anesthetic quinaldine in five species of both cold-water and warm-water fishes were measured following treatment with the new formulation, quinaldine sulfate. Quinaldine accumulated in relation to increasing temperature, treatment concentration, and length of exposure. Mean concentrations of quinaldine residues ranged from 1.18-8.31 μg/g for the 0-hour withdrawal time. Initial residues were higher in warm-water species than in salmonids. Although a wide range of residue concentrations (0.80-9.34 μg/g) occurred immediately after exposure, these residues are dissipated rapidly when the fish are placed in fresh water. All fish tested after 24 hours of withdrawal in fresh water contained 0.01 μg/g or less of quinaldine residue with the exception of the rainbow trout treated at 7° C.

394 SLADEN, William J.L., and William W. Cochran. 1969. Studies of the whistling swan, 1967-1968. Trans. 34th North Am. Wildl. & Natl. Res. Conf. No. 34, pp. 42-50.

During the two winters of study on the whistling swan in 1967-1969, 53 out of a total of 178 birds were captured by drugs. A combination of a tranquilizer, Diazepam, mixed in bait with

an anesthetic, alpha-chloralose, showed great promise for catching large numbers of swans at one time. However, the author stressed that this drug method needs further carefully controlled experiments.

395 SMITH, Neal Griffith. 1967. Capturing seabirds with Avertin. J. Wildl. Manage. Vol. 31, no. 3, pp. 479-483.

The narcotizing agent Avertin (tribromoethanol) proved an effective aid in capturing large numbers of gulls, cormorants, boobies, and frigate birds. Avertin should be most effective for species that can be attracted in large numbers to a baited area and will eat pieces of bait capable of concealing glycerine capsules containing the drug. By giving Avertin in lethal doses (2.2 g/kg of body weight), and then quickly flushing out the excess drug from the stupefied birds, individual variation in susceptibility became unimportant, narcosis was rapid, recovery times were acceptable, and there were no adverse aftereffects. The stomach irrigation process should be perfected before widescale captures are attempted. Avertin is not recommended for studies where no mortality can be tolerated.

396 SMITH, W.B. 1968. The propagation of striped bass. Dingell-Johnson Report, North Carolina, Proj. #F-016-R-04/WP-07/J-A/FIN. 17 pp. (DPL-FWRS 32-6944620).

While doing research on striped bass during their spawning season, the female fish were exposed to 3-7 ppm of quinaldine. These females were quickly subdued within 5 minutes and egg samples were collected with ease, without the fish being excited. The author suggests that quinaldine not be used when ovulation is imminent, as this anesthetic may cause the fish to release eggs into the aquarium. Fish, when placed in 7 ppm of quinaldine, were anesthetized for periods up to two hours and showed no adverse side effects.

397 SNOW, Herbert N. 1959. Surgical procedures as related to the pet and wild bird. Calif. Vet. Vol. 12, no. 6, p. 19.

The author of this article recommends ether as the general anesthetic when surgical procedures are required on birds. No drug amounts are given.

398 SOIFER, F.K. 1968. Surgery successful on 500 lb. tortoise. J. Am. Vet. Med. Assoc. Vol. 152, p. 418.

A 60-year-old Galapagos tortoise weighing 500 lb was anesthetized with metofane using a modified Ohio Heidbrink veterinary anesthesia unit with an improvised face mask made from a 3-pound coffee can. Anesthesia took 17 minutes to be induced and was maintained for 1 hour and 15 minutes.

399 SPECKMANN, G. 1975. Ketaset (ketamine HCl) anesthesia orchiectomy on a raccoon (Procyon lotor). J. of Zoo. Anim. Med. Vol. 6, pp. 31-32.

An operation to castrate a raccoon demonstrated the practicality and usefulness of Ketaset as a short-acting anesthetic for surgery in raccoons. The raccoon, approximately 4 months of age received a drug dosage of 20 mg/kg body weight. A total of 4 ml of Ketaset was rapidly injected into the biceps femoris muscle with no evidence of pain at the site of injection. Within 5 minutes after injection of the drug, the animal reached the surgical level of anesthesia. The eyes remained partially open throughout the operation, and the corneal, laryngeal, pharyngeal, and pedal reflexes remained intact. Anesthesia lasted approximately 40 minutes, and the recovery was smooth and uneventful.

400 STEFANOVA-MAZAKOVA, Z., V. Puchta, and A. Romanovsky. 1964. "The use of MS-222 in amphibians." In Small Animal Anesthesia, Proc. Symp. organized by British Small An. Vet. Assoc. & Univ. for An. Welfare; London; July, 1963. Oliver Graham-Jones, Ed. The Macmillan Co., New York. P. 77.

The common frog, Rana temporaria L., was anesthetized with MS-222 to determine the effectiveness of the drug on this amphibian. Both larval and adult stages were used. In all instances, the agent was dissolved in distilled water. For standardizing and comparing the narcotic effectiveness, concentrations of 1:1,000, 1:2,000, and 1:3,000 were used at a constant temperature of 20° C. The authors reported that the results of their experiments did not agree with the general conclusion described in other literature. MS-222 was found as satisfactory for the larval stages as it was for the adult stages of Rana temporaria L. Mortality was particularly low using concentrations of 1:2,000 and 1:3,000. Other advantages of the drug include excellent muscle relaxation with no known effect on the fertility of either the male or the female.

401 STEVENS, R.E. 1966. Hormone-induced spawning of striped bass for reservoir stocking. Prog. Fish Cult. Vol. 28, no. 1, pp. 19-28.

This paper reports on the striped bass (Roccos saxatilis), the holding ponds developed for this fish, the success obtained with several hormones, and the egg-taking procedures that proved successful. It was found that when the females were anesthetized with MS-222, the eggs could be manually stripped. Anesthesia usually resulted within 60-90 seconds when MS-222 was administered by spraying a water solution of the chemical onto the gills.

402 STEVENSON, D.E. 1964. "General aspects of rodent anesthesia." In Small Animal Anesthesia, Proc. Symp. organized by British Small An. Vet. Assoc. & Univ. Fed. for An. Welfare; London; July, 1963. Oliver Graham-Jones, Ed. The Macmillan Co., New York. Pp. 89-98.

This article discusses the many factors involved in successful anesthesia. The three main components are the animal, the anesthetic, and the anesthetist. It is a good general guide for aspects to be aware of before anesthetizing any animal, particularly rodents.

403 STEVENSON, D.E. 1964. "Inhalation anesthesia in rabbits, guinea pigs and hamsters." In Small Animal Anesthesia, Proc. Symp. organized by British Small An. Vet. Assoc. & Univ. Fed. for An. Welfare; London; July, 1963. Oliver Graham-Jones, Ed. The Macmillan Co., New York. Pp. 109-113, illus.

A combination of anesthetic procedures are recommended, as the use of a single technique is not always adequate. Induction of anesthesia may be easily obtained in rabbits, guinea pigs, and hamsters by the intravenous injection of a barbiturate or thiobarbiturate. When light anesthesia has been achieved, anesthesia can then be obtained by the administration of an inhalational agent. Alternatively, a premedicant drug such as chlorpromazine (1-5 mg/kg) can be given intravenously, intramuscularly, or intraperitoneally. This allows the animal to become relaxed and quiet, permitting induction of inhalational anesthesia to be carried out without any resistance. Other agents, besides the commonly used ether, are recommended because ether is highly inflammable and unpleasant to the animal.

404 STICKLEY, Allen R., Jr., and Joseph L. Guarino. 1972. A repellent for protecting corn seed from blackbirds and crows. J. Wildl. Manage. Vol. 36, no. 1, pp. 150-152.

Methiocarb [4-(methylthio)-3,-5-xylyl *N*-methylcarbamate] was tested as a seed treatment for repelling blackbirds and crows (Corvus sp.) from sprouting corn in South Carolina. The test was conducted on 8 fields within a 0.25-sq-mi area. Marked repellency occurred; sprout damage averaged 44% in the control fields and 0.3% in the fields treated with methiocarb.

405 STOLIKER, H.E. 1965. "The physiologic and pharmacologic effects of sernylan: A review." In Experimental An. Anesthesiology. D.C. Sawyer, Ed. USAF School Aerospace Med., Brooks Air Force Base, Texas. Pp. 148-184.

Phenylcyclidine hydrochloride (referred to as Sernylan, Sernyl CI-395, or GP-121) is discussed in some detail concerning its actions on the respiratory, circulatory, and the central nervous systems. The drug was tested in many animals including the raccoon, frog, mouse, rat, pigeon, and fish. A table summarizing the intramuscular doses of phenylcyclidine hydrochloride and the effects reported by investigators is included. Short-termed, repeated dose toxicity studies in rats, monkeys, and dogs were also performed.

406 STONE, C.P., W.F. Shake, and D.J. Langowski. 1974. Reducing bird damage to highbush blueberries with a carbamate repellent. Wildl. Soc. Bull. Vol. 2, no. 3, pp. 135-139.

An insecticidal level (1 lb/100 gal of water) of methiocarb [4-(methylthio)-3, 5-xylyl *N*-methylcarbamate] was applied to 1.5 acres of highbush blueberries (Vaccinium sp.) near Holland, Michigan, in mid-July 1972. After 14 days, bird damage to treated berries was 16.7% as compared with 44.2% on untreated berries, for an estimated savings of 2,159 lb valued at $648. Starlings (Sturnus vulgaris) and robins (Turdus migratorius) were the primary species involved in the damage.

407 STRACK, L.E., and H.M. Kaplan. 1968. Fentanyl and droperidol for surgical anesthesia of rabbits. J. Am. Vet. Med. Assoc. Vol. 153, pp. 822-825.

Twenty-two rabbits of mixed breeds were subjected to 31 surgical operations, with an intramuscular dose of 0.22 ml/kg

(1 ml/10 lb) of a combination of droperidol and fentanyl as the sole anesthetic agent. The drug combination given in 76 separate trail injections on 26 intact rabbits was safe and effective in a dose of 0.22 ml/kg. The adjunctive use of ether administered by nose cone to 20 rabbits extended the duration of droperidol-fentanyl anesthesia without complicating effects. In 10 rabbits, atropine was effective in reducing the bradycardia associated with droperidol-fentanyl anesthesia.

408 STREBKOVA, T.P. 1972. The effect of anesthetics (thiopental sodium) on the physiological characteristics of mirror carp underyearlings. J. Ichthyol. Vol. 12, no. 2, pp. 361-365.

There is an increase in the survival of carp underyearlings with thiopental sodium and kept without water (in a humid environment). The respiratory rate in experimental fish is reduced following anesthesia with thiopental sodium. The numerical expression of the blood indices is altered under the influence of environmental conditions; thiopental sodium in a concentration of 0.05 g/liter was not found to have a toxic effect on carp underyearlings.

409 STUNKARD, J.A., and J.C. Miller. 1974. An outline guide to general anesthesia in exotic species. Vet. Med./SAC. Vol. 69, no. 9, pp. 1181-1186.

This is a good general outline summarizing previous literature on the use of anesthetics in birds, skunks, raccoons, exotic cats, fish, subhuman primates, and rodents. Included are: drug dosages, methods of injection, types of drugs used, drug induction, and duration times. It is recommended that 10 mg (1 ml) of acepromazine be added to 10 ml ketamine for all species to minimize the excitatory phase during the recovery period.

410 SUTHERLAND, Ian, and John K. Hampton, Jr. 1961. A method of immobilizing snakes. Proc. An. Care Panel. Vol. 11, no. 2, p. 123.

A device was designed allowing convenience for immobilizing snakes and at the same time, comfort to the animal. The device is made of clear, rigid plastic with a 6-8" flat extension. The tail is attached by tape or clamps to the flat extension, and holes are drilled through the plastic tubing to provide adequate ventilation. Panels may be cut in the

plastic to have access to certain portions of the snake's body for limited surgery and injections. A drawing of the device is included within the paper.

411 SVENDSEN, Gerald E. 1969. Annotated bibliography on methylpentynol, No. 31. In Investigations in Fish Control. U.S. Dept. of Interior, Bur. Sport Fish. & Wildl. 7 pp.

An annotated bibliography containing 26 selected references on the biochemistry, physiology, and methods of analysis of methylpentynol.

412 SZABUNIEWICZ, Michael, and James D. McCrady. 1969. Some aspects of the anatomy and physiology of the armadillo. Lab. An. Care. Vol. 19, no. 6, pp. 843-848.

The physiology of the armadillo was extensively studied; and during experimental surgery, anesthesia was required. The animals were anesthetized with pentobarbital sodium (25-35 mg/kg) or a fentanyl-droperidol mixture. Both anesthetic agents were safe and reliable. Tracheal intubation was found necessary for prolonged procedures due to excessive salivation.

413 TABER, Robert, and Samuel Irwin. 1969. Anesthesia in the mouse. Fed. Proc. Vol. 28, no. 4, pp. 1528-1532, illus.

This review discusses anesthetic methods for mice. Handling and restraint, as well as choice of drugs and techniques, are described.

414 TAIT, John. 1938. Surgical removal of the poison glands of rattlesnakes. Copeia. No. 1, pp. 10-13.

Physiological experimentation on rattlesnakes was performed safely with the complete removal of their venom glands. This operation, to remove their glands, required a certain amount of technical equipment. An assistant to help bind the snake, act as the anesthetist, and participate in other duties should also be available. The snakes were individually placed in a glass covered box containing dilute chloroform vapor for 20-45 minutes. The depth of anesthesia was gauged in intervals according to spontaneous body and certain reflex movements. The steps for removal of the glands are detailed for the reader.

415 TANNER, James T. 1954. Some useful demonstrations in teaching zoology. Turtox News. Vol. 32, no. 1, pp. 2-4, part I.

Demonstrations and methods are described in this paper which are helpful in teaching zoology. It is recommended that when demonstrating the blood flow through the capillaries of a frog's webs, the frog be anesthetized to prevent movement of the foot. 1.5 ml of 10% chloral hydrate injected into the dorsal lymph sack works well in quieting the frog. The circulation of the frog will show little or no slowing down with the use of this drug.

416 TARIN, D., and A. Sturdee. 1972. Surgical anesthesia of mice: Evaluation of tribromoethanol, ether, halothane and methoxyflurane and development of a reliable technique. Lab. Animals. Vol. 6, pp. 79-84.

Methoxyflurane is easily the best of the 4 agents for producing well-controlled surgical anesthesia in mice. Its particular advantages are: operative and postoperative mortality are negligible, one person can both control the level of anesthesia and perform the surgical operation, there is no serious hazard for the administrator, and the anesthetic can be administered with very simple apparatus.

417 TATE, Bill, Tom Moen, and B.I. Severson. 1965. The use of rotenone for recovery of live fish. Prog. Fish Cult. Vol. 27, no. 3, pp. 158-160.

A recovery technique for fish using rotenone has been found less expensive and more efficient than seining in most nondrainable ponds. Ponds no larger than 5 acres and having regular shorelines work successfully under this technique. An outboard motor (5-10 horsepower for ponds up to 1 acre in size), placed at a strategic location along the shore, is used to establish a circulation pattern within the lake. Once this circulation pattern is established, diluted emulsified rotenone is discharged into the propwash to produce a calculated concentration of 0.5 ppm of rotenone in not less than 1/2 hour. Apparently the survival of the fish recovered depends on the temperature of the pond according to the data obtained. Of 2,922 fish accounted for, 2,229 were recovered using the rotenone technique for an overall recovery of 77%. This technique is highly recommended for obtaining fingerling largemouth bass from nondrainable ponds when they are needed for new or chemically treated waters.

418 TATUM, B.L., J.D. Bayless, E.G. McCoy, and W.B. Smith. 1965. Preliminary experiments in the artificial propagation of striped bass. Proc. 19th Annu. Conf. SE Assoc. Game and Fish Comm. Dingell-Johnson, North Carolina, Proj. # F-016-R. Pp. 374-389. (DPL-FWRS 32-7310210).

Striped bass (Roccus saxatilis) were obtained from commercial fishermen and from the Roanoke River in North Carolina by electrofishing. These fish were injected with hormones and spawned. From observations made, it became apparent that changes in pH and/or other chemical characteristics were lethal to fry. The 24-hour median tolerance limit values determined were quinaldine = 22.0 ppm, MS-222 = 50 ppm, salt (NaCl) = 4,830 ppm, and pH = 5.3. The 2-hour TL_m values were also determined. Quinaldine appeared superior to MS-222 as a tranquilizer for striped bass. The salinity and use of these tranquilizers on fingerlings had no apparent effect on handling mortality.

419 TAYLOR, R.H., and W.B. Magnussen. 1965. Immobilizing live-trapped opossums with succinylcholine chloride. New Zealand J. Science. Vol. 8, pp. 531-536, illus.

Succinylcholine chloride was administered intramuscularly to 97 live-trapped brush-tailed opossums (Trichosurus vulpecula). During field studies, the most convenient dose to aid in handling was found at 0.65 mg/kg. At this dose level, the drug normally took effect in about 5 minutes and the opossum was immobilized for about 10 minutes. The results and techniques for immobilizing these animals are included.

420 TEMPLE, Robert, and Murray E. Fowler. 1978. "Amphibians" in Zoo and Wild Animal Medicine. Murray E. Fowler, Ed., W.B. Saunders, Philadelphia. Pp. 79-88.

Tricaine methanesulfonate (MS-222) is the anesthetic recommended for use in amphibians. A concentration from 1:1,000 to 1:5,000 (0.1-0.5 percent) is needed for anesthesia to result, while lower concentrations are used on larval forms. Sedation should occur within 5 minutes after the amphibian has been immersed in the anesthetic solution. Recovery generally follows in 15-30 minutes after the animal has been transferred to fresh water.

421 THIENPOINT, D., and C.J.E. Niemegeers. 1965. R7464 - A new potent anaesthetic in fish. International Zoo Yearbook. Vol. 5, pp. 202-205.

Tests have been carried out on goldfish (Carassius auratus), sunfish (Eupomotis gibbosus), rainbow trout (Salmo gairdneri), marine fish, and amphibians with the drug R7464. R7464 is a soluble, atoxic, potent, and polyvalent anesthetic for both fish and amphibians. Depending upon the concentrations used and the immersion times allowed, varying degrees of anesthesia can be produced. A description of the materials, techniques, and results are discussed within the paper.

422 THOMPSON, Paul E. 1958. Urethane and cancer. Prog. Fish Cult. Vol. 20, no. 3, p. 128.

The author of this article requests verified reports of tumors, growths, or other cancerous conditions in fish caused possibly by urethane or other chemicals. Special precautions are recommended for anyone using urethane and it is suggested that a suitable substitute be used.

423 THOMPSON, R.B. 1959. Tricaine methanesulfonate (MS-222) in transport of cutthroat. Prog. Fish Cult. Vol. 21, no. 2, p. 96.

A technique was desired to narcotize small trout and reduce the water-to-fish ratio. Tricaine methanesulfonate (MS-222) was chosen and given in varying concentrations: 1:20,000, 1:40,000, 1:60,000, 1:80,000 or 1:120,000. After a 5-hour hike to the lake, a 95% mortality was noted with the 1:20,000 concentration; the other concentrations gave little difference in survival. All the fish recovered in good condition from concentrations of 1:40,000 or greater. A week later, only 6 ml of the 1:40,000 solution was used per g of fish (equivalent of 2.5 qts of water per lb of fish, or 1/8 of the weight of water usually carried). Three-thousand cutthroat fingerlings to the pound were placed in each container and no oxygen was used. Three hours later the fish were released in the lake - 2,000 live fish to 19 mortalities.

424 THORSON, Thomas B. 1959. Tricaine methanesulfonate as an anesthetic for the sea lamprey, Petromyzon marinus. Copeia. No. 2, pp. 163-165.

The sea lamprey of the Great Lakes, Petromyzon marinus, was anesthetized with the help of tricaine methanesulfonate (MS-222). Individually, 6 lampreys were placed in 7 varying concentrations, ranging from 0.05-2.0 g/liter. As dosages were increased, a reduction in the time for anesthesia and an increase in recovery time were noted for both respiratory and muscular activity. No deaths resulted at any of the concentration levels. A concentration of 0.25 g/liter produced anesthesia relatively quickly, and the recovery was generally rapid.

425 TIGNER, James R. and Walter A. Bowles. 1964. Chloropicrin tested as an area repellent for house mice. J. Wildl. Manage. Vol. 28, no. 4, pp. 748-751.

Chloropicrin was evaluated as an area repellent for house mice (Mus musculus). Two granaries - one for treatment and one for control - were modified into testing chambers by equipping a connecting runway with photoelectric cells and tally-counters which recorded animal activity. Four approximate concentrations of chloropicrin, determined by holes punched in the container, were evaluated, and activity was reduced 23-83% in the treated granaries. It was concluded that the biological activity of chloropicrin is both repellent and toxic and that chloropicrin will remove house mice from confined spaces if correct concentrations are chosen.

426 TUFFERY, A.A. 1957. "The mouse." In UFAW (eds.): Handbook on the care and management of laboratory animals. P. 262.

The author feels that ether is very satisfactory for anesthetizing mice for short periods of time. The recommended method is to place the animals into a 10" desiccator, allowing ether vapor to be pumped into this holding device. A simpler method is to place a wad of cotton-wool soaked in ether under the gauze in the lower half of the desiccator. Nembutal is recommended for long periods of anesthesia, followed in accordance with the maker's instructions.

427 VALENSTEIN, Elliot S. 1961. A note on anesthetizing rats and guinea pigs. J. Exp. Anal. Behav. Vol. 4, p. 6.

Due to the difficulty many workers find in anesthetizing small animals in laboratories, a variety of drugs have been tried. At the Walter Reed Army Institue of Research, intraperitoneal

injections of chloral hydrate have been used to supplement pentobarbital sodium. Chloral hydrate has been used as the sole anesthetic for rats and guinea pigs (400 ml/kg). Although this drug has a very wide margin of safety and relatively quick action, some animals were lost because of the side effects of this compound. A table is included with the paper that provides dose levels of pentobarbital sodium for rats and guinea pigs in the 200-700 g weight range.

428 VAN PELT, Lloyd, F. 1977. Ketamine and xylazine for surgical anesthesia in rats. J. Am. Vet. Med. Assoc. Vol. 171, no. 9, pp. 842-844.

In a series of preliminary trials, intramuscular doses of ketamine and xylazine were used singly and in combination form in rats. When either of the drugs was given alone, adequate anesthesia was not reached. When the 2 drugs were administered together, a synergistic effect was observed, resulting in anesthesia with extended analgesia and immobility. In most rats, anesthesia resulted when rats were given 87 mg ketamine/kg of body weight and 13 mg xylazine/kg simultaneously by injection. The effects would begin to take place 10-15 minutes after the injection and would last 15-30 minutes, followed by a relatively long period of immobility (mean 3.8 hours) and reduced responsiveness to external stimuli. Initial and supplemental doses of up to 3 times the amount were administered without incident.

429 VAN WYHE, G.L. 1964. Investigations of the Tanana River grayling fisheries, migratory study. Dingell-Johnson Report, Alaska, Proj. # F-005-R-05/WP-14/J-B. Pp. 353-368. (DPL-FWRS 50-6940750).

Due to excessive anesthetization and warm water temperatures, occasional losses of fish have been recorded by the State of Alaska using tricaine methanesulfonate (MS-222). When the water reaches a temperature of 55° F or warmer, the amount of anesthetic becomes very important. Fish that have received the same amount of anesthetic will die in less than 10 min at 55° F, while they will not be immobilized at 48° F. This paper also reports on capturing methods, growth rates, and effectiveness of tagging.

430 VERTS, B.J. 1960. A device for anesthetizing skunks. J. Wildl. Manage. Vol. 24, no. 3, pp. 335-336.

A device was designed which would allow an operator to stand about 9 ft from skunks (Mephitis mephitis) and inject liquid drugs by intraperitoneal injections. It was found that a solution of pentobarbital sodium (60 mg/cc) at a rate of 1.0 cc per 6 lb of body weight (estimated) is a safe anesthetic for skunks. A listing of the material required for construction of the anesthetizing device is given.

431 VROOMAN, Andrew M., and Pedro A. Paloma. 1966. Experimental tagging of the northern anchovy (Engraulis mordax). Calif. Fish and Game. Vol. 52, no. 4, pp. 228-239.

Experiments were performed on the northern anchovy (Engraulis mordax) to test the effects of several factors on fish mortality and tag loss: (1) anesthetic, (2) tag size, (3) handling, (4) antibiotic, and (5) tagging conditioned and unconditioned fish. A solution of 7 ppm quinaldine (2-methylquinoline, Eastmen P216) was used to anesthetize several anchovies to determine a suitable place on the fish for tag insertion. Thereafter, during experiment 1,200 anchovies were anesthetized, tagged, and released into 1 of the enclosures, while 200 others were placed in separate enclosures as controls. The results showed that immediate mortality accounted for 204 of the 1,200 fish that had been anesthetized, but only 1 of the 1,200 handled without an anesthetic. The other factors tested, as mentioned above, are discussed and summarized in this paper also.

432 WALKER, Charles R., and Richard A. Schoettger. 1967. Method for determining MS-222 residues in fish, No. 14. In Investigations in Fish Control. U.S. Dept. of Interior, Bur. Sport Fish. & Wildl. Pp. 3-10.

MS-222 is a primary aromatic amine. Its diazonium salt reacts with the Bratton-Marshall reagent (*N*-1-naphthylethylenediamine dihydrochloride) to form a wine-red azo dye with a maximum absorbance at 545 millimicrons. The diazotization reagent had to be modified and the reaction time extended to obtain a measurable yield of the diazonium salt. The regression of absorbance values versus concentrations of MS-222 was spiked into samples of blood, muscle, liver, and kidney from rainbow trout, and excellent recoveries were measured by the analytical method. The residues had to be distinguished from a background of primary aromatic amines which varied in each tissue, between individual specimens, and with each lot of fish. Backgrounds were higher in liver and kidney, and residues of MS-222 were more difficult to differentiate. The method was particularly effective in determining residues of the drug in muscle and blood of trout.

433 WALKER, Charles R., and Richard A. Schoettger. 1967. Residues of MS-222 in four salmonids following anesthesia, No. 15. In Investigations in Fish Control. U.S. Dept. of Interior, Bur. Sport Fish. & Wildl. Pp. 3-11.

Residues of MS-222 (tricaine methanesulfonate) in the blood, muscle, liver, and kidney of rainbow trout and in the muscle of brown, brook, and lake trout were measured by a modified Bratton-Marshall colorimetric method. Temperatures were 7°, 12°, and 17° C in waters with total hardnesses of 10-180 ppm. The residues were easily detected and measured in blood and muscle, but they were masked in liver and kidney by background substances. The anesthetic dissipated rapidly in the muscle of the four species within 1-6 hours, and the residues approached the background levels of controls within 9-24 hours after withdrawal from exposure. The differences in residue levels in the muscle at 0-hour withdrawal between species, at three temperatures, and in soft and hard water largely disappeared within 24 hours.

434 WALLACH, J.D. 1969. Medical care of reptiles. J. Am. Vet. Med. Assoc. Vol. 155, no. 7, pp. 1017-1034.

This paper reports on the availability of alternatives in anesthetizing reptiles. Neoplasms, bacterial and foreign-body granulomas, suturing lacerations, and other minor surgical procedures may easily be performed using manual restraint supplemented with local infiltration of xylocaine hydrochloride around the surgical site. The author has had good success in using M-99 in crocodilians, tortoises, turtles, and snakes when clinical and/or surgical procedures were necessary. Injectable and inhalant anesthetics are discussed, and drug dosages are given. The remainder of the chapter deals with the anatomy, physiology, diseases, and radiographic techniques that may be used in reptiles.

435 WALLACH, Joel D. 1974. "Anesthesia of reptiles." In Current Veterinary Therapy V-Small Animal Practice. Robert W. Kirk, Ed. Pp. 638-641.

The various ways of anesthetizing reptiles by means of hypothermia, electroanesthesia, injectable and inhalant agents are discussed in this article. Many injectable drugs have successfully been used on turtles, tortoises, American alligators, and snakes. Drug doses and techniques are given.

436 WALLACH, J.D., and Charles Hoessle. 1970. M-99 as an immobilizing agent in poikilotherms. Vet. Med./SAC. Vol. 65, no. 2, pp. 163-167.

Large crocodilians being relocated from outdoor summer quarters to heated winter facilities underwent a series of experiments in the research laboratory of the St. Louis Zoo to determine adequate dosages of the immobilizing agent M-99 (Etorphine ®, American Cynamid). The large crocodilians were administered the drug by projectile syringe, while the small crocodilians received the drug through a hand syringe. Good immobilization was found to occur in small laboratory-sized alligators when small doses (0.05 mg) were administered intramuscularly in the base of their tails. When the same dose was administered intraperitoneally, the induction time was reduced approximately 50%, and the duration of the effect was only slightly increased. Further experiments using larger intraperitoneal and intramuscular doses (5 mg) in small crocodilians indicated the intraperitoneal method had the best overall effect with shortest induction periods. Four large crocodilians (84-129 lbs) were given 15-20 mg of M-99 subcutaneously or intramuscularly. One of these large animals receiving 15 mg of M-99 subcutaneously showed no effect during 8 hours of observation. The three other large crocodilians given 20 mg of M-99 intramuscularly were sufficiently immobilized in 20 minutes to easily be handled. Similar experiments using M-99 on red-ear turtles, Galapagos tortoises, and leopard frogs are also discussed.

437 WAMPLER, Stanley N. 1969. Husbandry and health problems of armadillos, Dasypus novemcinctus. Lab. An. Care. Vol. 19, no. 3, pp. 391-393.

Sodium pentobarbital worked extremely well in armadillos when given at a drug dosage of 25 mg/kg through the superficial femoral vein. Smooth induction was obtained when 1/2 the calculated dose was given, followed by slow administration of the additional amounts to the desired level of anesthesia. Local anesthesia has also been performed using lidocaine hydrochloride. Medical problems, preventive measures, husbandry, and pregnancy diagnosis in armadillos are reported in this paper.

438 WARNER, G.W. 1958. Environmental studies of the grayling of Alaska. Dingell-Johnson Report, Alaska, Proj.# F-001-R-07/WP-C/J-03/B. 17 pp. (DPL-FWRS 50-6940648).

Chlorobutanol was used at the rate of 1/2 g/gal of water to anesthetize grayling for tagging in the Big Delta area of Alaska. One fish at a time was placed in the chlorobutanol solution allowing the fish to become unconscious. At this time, the fish was removed from the solution, measured, tagged, and put into a recovery tank. Once the fish obtained its normal swimming ability, the fish was released. Handling injury was greatly reduced and standardized the condition of released fish.

439 WARNER, G.W. 1959. Environmental studies of the grayling of Alaska. Dingell-Johnson Report, Alaska, Proj.# F-001-R-08/WP-C/J-03/C. 13 pp. (DPL-FWRS 50-6940652).

Chlorobutanol, MS-222, and quinaldine were tried as anesthetics on grayling trout before tagging. Any of these drugs produced the desired effect on grayling. After the initial trials, MS-222 was used extensively at a rate of 1:20,000. After 3 minutes in the solution, the fish were handled with ease. The paper includes valuable information on various fish tags.

440 WARREN, Alan G. 1964. "An apparatus for administering inhalation anesthetics to small mammalian subjects." In Small Animal Anesthesia, Proc. Symp. organized by the British Small Animal Vet. Assoc. and Univ. Fed. for Animal Welfare; London; July, 1963. Oliver Graham-Jones, Ed., The Macmillan Co., New York. Pp. 239-243, illus.

Apparatus that may be used on smaller mammalian animals in the laboratory or in clinical practice is described and illustrated. Pieces of laboratory equipment or apparatus used for anesthetizing dogs and cats may be used to successfully anesthetize these smaller animals.

441 WASS, John A., and Harold M. Kaplan. 1974. Methoxyflurane anesthesia for Rana pipiens. Lab. Am. Science. Vol. 24, no. 4, pp. 669-671.

Methoxyflurane worked extremely well in anesthetizing grass frogs (Rana pipiens). By placing a cotton ball moistened with 10 ml of methoxyflurane in a 1-gal jar containing a frog, anesthesia could be achieved effectively. Air was admitted through a 3/16" hole in the cover. The frogs reacted to the anesthetic in an excitory manner, followed in about 2 minutes by deep anesthesia which lasted for approximately 38 minutes.

Pulse and cloacal temperatures were unaffected, but respiration slowed during induction. Ketamine hydrochloride was used in combination with methoxyflurane and by itself to determine its suitability in anesthetizing frogs. Due to the severely depressed pulse and respiration rates, the use of ketamine or ketamine-methoxyflurane mixtures are discouraged in Rana pipiens.

442 WASS, John A., James R. Keene, and Harold M. Kaplan. 1974. Ketamine-methoxyflurane anesthesia for rabbits. Am. J. Vet. Res. Vol. 35, no. 2, pp. 317-318.

Ketamine hydrochloride was successfully used to anesthetize rabbits, producing excellent relaxation. The drug was intramuscularly injected at a dose of 44 mg/kg for rabbits weighing less than 2.3 kg, and 55 mg/kg in rabbits weighing more than 2.3 kg. By the use of a nasal cone, methoxyflurane was administered within 5 minutes of the ketamine to achieve deep surgical anesthesia and intermittently thereafter as needed. Surgical procedures were then performed lasting an average of 72 minutes. There were no complications, and the induction of anesthesia was smooth. Using a combination of the two drugs, the dangers of respiratory failure and short duration of anesthesia induced that are normally found using ketamine alone were avoided.

443 WATSON, John E. 1961. Tricaine methanesulfonate as an anesthetic for herring. Prog. Fish Cult. Vol. 23, no. 4, p. 174.

Herring (Clupea harengus), measuring 5" in length, were anesthetized effectively in about 8 minutes using tricaine methanesulfonate dissolved at 1:20,000 in sea water of 30 parts per thousand and 8° C. The fish reached total anesthesia when there was no response to a gentle tap. After the fish arrived at this stage of anesthesia, they offered no resistance to handling. The fish resumed their normal swimming pattern after being returned to untreated circulated seawater in about the same time as it originally took to induce anesthesia. One week after anesthetization, the four groups of ten fish were considered "wholly" recovered.

444 WEATHERALL, Josephine A.C. 1960. Anesthesia in new-born animals. British J. Pharmacol. Vol. 15, p. 454-457.

Pentobarbitone was more toxic to newborn than to adult rabbits and rats. It produced a longer loss of righting reflex in newborn animals, but did not anesthetize them effectively in less than toxic doses. Urethane did not anesthetize newborn animals in doses which anesthetize adults. Ether produced loss of righting reflex at lower concentrations for newborn than for adults, but the newborn animals became anesthetized more slowly.

445 WEBB, Robert Taylor, Jr. 1954. Tricaine methanesulfonate (MS-222) as an anesthetic for some common pond fishes. M.S. thesis. Alabama Polytechnic Institute. Auburn, Alabama. 55 pp.

The effectiveness of MS-222 (tricaine methanesulfonate) as an anesthetic was tested on the golden shiner (Notemigonus crysoleucas), goldfish (Carassius auratus), bluegill (Lepomis macrochirus) and fathead minnow (Pimehales promelas). Concentrations of 0.1, 0.2, 0.4, and 0.8 g/gal were used. The effect of MS-222 was essentially the same at temperatures of 50°, 60°, 70°, and 80° F. The minimum concentration at which golden shiners, goldfish, bluegills, and fathead minnows were anesthetized was 0.4 g/gal with an exposure time of 2 minutes for the golden shiners, 9 minutes for goldfish and bluegills, and 4 minutes for the fathead minnows. The fish were kept in aquaria for 3 days after being anesthetized in order to observe the aftereffects of MS-222. It was found that fatheads suffered 80-100% mortality when exposed to concentrations of 0.4 g/gal or higher. The other species tested seemed to be unaffected.

446 WEBB, Robert T., Jr., 1958. Distribution of bluegill treated with methanesulfonate (MS-222). Prog. Fish Cult. Vol. 20, no. 2, pp. 69-72.

In order to increase the number or pounds of bluegill which could be hauled on distribution trips, tests were performed to help determine the optimum concentration of MS-222 necessary to anesthetize fish. The data obtained indicated that 0.1 g MS-222/gal was the most promising concentration to use in distribution. However, control fish were carried as well as the drugged fish. Eight tables listing the data obtained are included.

447 WEBB, W.E. 1962. Toxicity tests on insecticides and herbicides. Water quality investigations. Dingell-Johnson Report. Idaho, Proj. # F-034-R-04/J-04. 14 pp. (DPL-FWRS 11-6841774).

Two anesthetic drugs, MS-222 and quinaldine, were tested to determine their anesthetic effect on chinook salmon fingerlings and rainbow trout fingerlings. Two diluent waters having various chemical properties (i.e., alkalinity, hardness, etc.) were tested in order to determine the effect of water chemistry on the efficiency of these drugs. No influence was observed. These drugs appeared efficient and rapid-working in the fingerling salmonids used. Quinaldine was easier to use due to its liquid form and was more rapid working on salmon fingerlings. This report also includes bioassays of toxicity of a toxaphene and dieldrin on mayfly nymphs and amphipods.

448 WEBSTER, D.M., and Valerie D. Hollard. 1973. A safe and simple injection anesthetic for birds. Physiol. Behav. Vol. 10, no. 4, p. 831.

An injection procedure using chlormethiazole (Hemineurin) and ketamine hydrochloride (Ketalar) was found very effective in giving a suitable depth of surgical anesthesia and had a wide margin of safety. After injection of the anesthetic into the pectoral muscles, induction normally occurred within 10 minutes. A satisfactory depth of anesthesia in pigeons was reached using 180 mg/kg of chlormethiazole and 25 mg/kg of ketamine hydrochloride.

449 WEDEMEYER, Gary. 1970. Stress of anesthesia with MS-222 and benzocaine in rainbow trout (Salmo gairdneri). J. Fish Res. Bd. Can. Vol. 27, no. 5, pp. 909-914.

Rainbow trout (Salmo gairdneri), anesthetized with MS-222 for periods up to 12 minutes, experience interrenal ascorbate depletion, uremia, and moderate hypercholesterolemia. Anesthesia with neutralized MS-222 (pH 7) or benzocaine prevented these changes and significantly reduced the variability in plasma glucose, cholesterol, and cortisol, indicating that the stress of anesthesia with MS-222 is due to the low pK of the sulfonic acid moiety.

450 WEISBROTH, S.H., and J.H. Fudens. 1972. Use of ketamine hydrochloride as an anesthetic in laboratory rabbits, rats, mice and guinea pigs. Lab. An. Science. Vol. 22, no. 6, pp. 904-906.

Ketamine hydrochloride was evaluated as an agent for chemical restraint and surgical anesthesia in laboratory rabbits, rats, mice, and guinea pigs. In all 4 species, intramuscular doses of 44 mg/kg provided adequate anesthesia for surgical procedures requiring 15-25 minutes operating time. Induction time approximated 8-10 minutes, and recovery was generally complete 30-45 minutes after injection. Intramuscular injections of 22 mg/kg provided adequate chemical restraint for a variety of procedures.

451 WEST, Richard R., Ronald B. Brunton, and Donald J. Cunningham. 1969. Repelling pheasants from sprouting corn with a carbamate insecticide. J. Wildl. Manage. Vol. 33, no. 1, pp. 216-219.

The protection of sprouting corn from pheasants (Phasianus colchicus) by treating the seed with a new repellent, ORC-736 [4-(methylthio)-3, 5-xylyl *N*-methylcarbamate], was evaluated in May and June 1967 on the Sand Lake National Wildlife Refuge, South Dakota. The three treatments (0.5 and 3.0% DRC-736 and the control) were each evaluated 100 times on 0.016-acre plots in each of four fields. The number of corn seedlings pheasants destroyed in the 400 plots of each treatment was 2,192 for the control but only 99 in the 0.5% plots and 59 in the 3.0% plots. This effective repellency did not occur until entire fields were treated instead of small plots within fields.

452 WHITE, Gary L., and Donald D. Holmes. 1976. A comparison of ketamine and the combination ketamine-xylazine for effective surgical anesthesia in the rabbit. Lab. An. Science. Vol. 26, no. 5, pp. 804-806.

Ketamine alone and the combination ketamine-xylazine were evaluated as surgical anesthetics in rabbits. It was found that ketamine alone provided inadequate analgesia for ventral abdominal incisions or exposure of the femur. The combination of xylazine with ketamine did provide adequate analgesia for both surgical procedures.

453 WHITTOW, G.C., and N. Ossorio. 1970. A new technic for anesthetizing birds. Lab. An. Care. Vol. 20, no. 4, pp. 651-656, illus.

A new technic using halothane or methoxyflurane for anesthetizing birds was described. The anesthetic vapor was introduced directly into the air sac system. The method incorporated a highly effective means of resuscitation.

454 WIGHT, Howard M. 1953. A suggested method of capturing birds with narcosis-producing drugs. Proc. Midwest Wildl. Conf. Vol. 15, 3 pp.

An alternate method to capturing game birds is suggested in this paper using the drug Avertin (tribromoethanol). Leghorn cockerels, bobwhite quail, and mourning doves received the drug-coated grain in dose strengths from 2%-100%. Varied responses resulted from birds eating the grain treated with Avertin. The weight of the bird and the strength of solution with which the baits were treated determined the speed of the onset of narcosis. Precautions, limitations, and other information on this narcotic drug are included.

455 WILLIAMS, Lovett E., Jr. 1966. Capturing wild turkeys with alpha-chloralose. J. Wildl. Manage. Vol. 30, no. 1, pp. 50-56.

During approximately 1 year of experimental field use in Florida, 260 wild turkeys (Meleagris gallopavo) were captured with alpha-chloralose, an oral anesthetic. Two grams of the powdered drug per cup of bait, used without regard for the amount consumed by each individual, proved to be the most effective dosage. Eight of the 87 turkeys captured with this dosage died. Heavier dosages resulted in greater mortality and lighter dosages often produced subeffective narcosis. A surgical technique is described which is capable of eliminating nearly all overdosage mortality by removal of excess bait from the crop soon after capture.

456 WILLIAMS, Lovett E., Jr. 1967. Preliminary report on methoxymol to capture turkeys. Proc. 21st Ann. Conf. SE Assoc. Game and Fish Comm. Pp. 189-193, illus. (DPL-FWRS 09-7220145).

In Florida, 113 wild turkeys (Meleagris gallopavo) were sufficiently narcotized to be captured with methoxymol, which had been applied to bait. Four grams of powdered drug per cup of bait was found to be the optimum dosage and the first evidences of narcosis were noted almost immediately. Some of the turkeys were easily captured within 3 minutes of the time they had started feeding, and narcosis wore off after 8 hours even when the bird had been heavily drugged. The drug was found to be quite safe; an overdose rate mortality of less than 3% at optimum dosage rates was noted.

457 WILLIAMS, Lovett E., Jr., and Robert W. Phillips. 1972. Tests of oral anesthetics to capture mourning doves and bobwhites. J. Wildl. Manage. Vol. 36, no. 3, pp. 968-971.

Three oral anesthetics were tested on free-feeding wild mourning doves (Zenaidura macroura) and bobwhite quail (Colinus virginianus) to evaluate the oral drug capture technique. Tribromoethanol was the best for both species. The best dosages for doves were between 3.50 and 6.00 g of drug per cup of cracked corn. Oral drugs appear to be less useful for capturing doves than for capturing quail, but field tests comparing this method with conventional trapping methods are needed. The oral drug method of capture may not be as successful for small flocking birds as it is for larger birds.

458 WILLIAMS, Lovett E., Jr., and Robert W. Phillips. 1973. Capturing sandhill cranes with alpha-chloralose. J. Wildl. Manage. Vol. 37, no. 1, pp. 94-97.

A total of 266 wild sandhill cranes (Grus canadensis) were captured in 17 field tests of alpha-chloralose, and 41 were captured in four attempts with recoilless rocket nets in Florida. Thirty-nine of those captured with alpha-chloralose died; four were killed by the netting operations. Cranes taking bait treated with 0.45-0.50 g of alpha-chloralose per cup of bait were narcotized sufficiently to be captured from 1-3 hours later. Of 69 cranes captured with either 0.45 or 0.50 g of drug per cup of bait, only two died of overdosage, suggesting that the optimum dosage lies in that range. A lighter dosage (0.35) was ineffective and heavier dosages (0.62 and 2.00) resulted in excessive mortality. Some of the advantages of the two capture methods are discussed briefly.

459 WILLIAMS, Lovett E., Jr., David H. Austin, and Jerry Peoples. 1966. Progress in capturing turkeys with drugs applied to baits. Proc. 20th Annu. Conf. SE Assoc. Game and Fish Comm. Vol. 20, pp. 219-226.

Powdered alpha-chloralose, applied to bait, was administered to approximately 833 wild turkeys (Meleagris gallopavo) in Florida. The optimum dosage rate was determined to be 2 g of alpha-chloralose per cup of bait. A review of the capturing, handling, effects of alpha-chloralose on reproduction, mortality rates, and research suggestions are all included. The faster acting drug, methoxymol (R-7315), which has similar properties to alpha-chloralose, is briefly mentioned. A summary in chart form gives the results from a field test in which methoxymol was used. Most turkeys failed to feed on the methoxymol bait after the first taste as the bait was found to be very distasteful. Otherwise, the findings for this drug were encouraging.

460 WILLIAMS, L.E., Jr., D.H. Austin, N.F. Eichholz, T.E. Peoples, and R.W. Phillips. 1968. Study of nesting turkeys in southern Florida. Proc. 22nd Ann. Conf. SE Assoc. Game and Fish Comm. Vol. 22, pp. 16-30. (DPL-FWRS 09-7220144).

Twenty adult and 6 juvenile hen turkeys (Meleagris gallopavo) were captured with orally administered alpha-chloralose and later fitted with miniature tracking transmitters. There was no evidence that this drug interfered with hatchability.

461 WILLIAMS, T.D., and F.H. Kocher. In Press. A comparison of anesthetic agents in the sea otter.

462 WILSON, P. 1976. Chemical restraint in the pine martin. Vet. Rec. Vol. 98, no. 15, pp. 302-303.

Ketamine hydrochloride (Vetalar; Parke-Davis) was very satisfactory in immobilizing the pine martin (Martes martes). Ketamine hydrochloride was administered intramuscularly into the gluteal muscles at a rate varying from 5 mg/kg to 11 mg/kg. It was determined that 5 mg/kg was adequate only if the animal was accustomed to being handled. A dose rate of 7 mg/kg was considered the most suitable for immobilization.

463 WIMSATT, William A. 1978. "Vampire bats" in Zoo and Wild Animal Medicine. Murray E. Fowler, Ed. W.B. Saunders Co. Philadelphia. Pp. 507-513.

Anhydrous ether has satisfactorily been used to anesthetize vampire bats. Anesthesia may be obtained by dropping the bat into a widemouth quart museum jar containing a wad of cotton slightly moistened with a few drops of ether and replacing the cover of the jar. The animal should be removed from the jar approximately 45 seconds later when it is barely comatose. Anesthesia may be deepened or prolonged as necessary by an ether cone or small wad of ether-moistened cotton placed tentlike over the bat's head. No other anesthetics have been tried, as ether has worked quite successfully.

464 WINGFIELD, W.E., and D.W. DeYoung. 1972. Anesthetic and surgical management of eagles with orthopedic difficulties. Vet. Med./SAC. Vol. 67, no. 9, pp. 987-993.

During a course of 4 months, 4 eagles with orthopedic problems were seen at the University of Missouri Veterinary Clinic. Equal amounts of oxygen and nitrous oxide were administered through a face-mask. Halothane was slowly added to this mixture in order to induce anesthesia gradually. Anesthesia was maintained using an anesthetic machine with an endotracheal catheter inserted into the trachea. Indications of anesthesia included sluggish or near absent corneal reflexes and no responses to pinching of the skin and interdigital web. The case histories of these birds are reported.

465 WOOD, E.M. 1956. Urethane as a carcinogen. Prog. Fish Cult. Vol. 18, no. 3, pp. 135-136.

It is suggested that precautions be taken when using the anesthetic urethane. This substance is known to cause leucopenia in humans and lung tumors in mice.

466 YANKOW, Maurice. 1962. An unusual case of limb regeneration. Turtox News. No. 40, no. 6, pp. 146-148.

An investigation was performed to determine if a growth substance was involved in regeneration of limbs in amphibians. A frog (Rana pipiens) was anesthetized in the process by placing it in 100 ml of a 0.1% solution of tricaine methanesulfonate. The frog was considered anesthetized when placed on its back and no righting movements were attempted.

467 YOUNG, Ripley, and Harold M. Kaplan. 1960. Anesthesia of turtles with chlorpromazine and sodium pentobarbital. Proc. An. Care Panel. Vol. 10, no. 2, pp. 57-61.

Adult Pseudemyd turtles adapted to external temperatures between 20°-23° C were anesthetized with an intramuscular injection of 10 mg/kg of chlorpromazine followed after 10 min by an intracardiac injection of 10 mg/kg of sodium pentobarbital. Surgical anesthesia was induced in 15 min from the start of injections. The surgical duration was approximately 3 hours. Chlorpromazine premedication shortens the induction time obtainable with pentobarbital alone.

468 YOUNG, R., H.M. Kaplan, and M.R. Kaplan. 1960. Chlorpromazine pre-medication with pentobarbital anesthesia in the turtle. Fed. Proc. Vol. 19, p. 273. (Abs.).

Adult temperature-adapted turtles of the species Pseudemys scripta were readily brought into deep anesthesia with an intramuscular injection of 10 mg/kg of chlorpromazine hydrochloride S.K.F. (Thorazine), followed after 10 min by an intracardiac injection of 10 mg/kg of sodium pentobarbital in aqueous solution. The range of external temperature was 20°-23° C. The total time needed to induce deep (surgical) anesthesia averaged approximately 15 min from the start of injection. The average duration of anesthesia at all depths was approximately 4 hours, and that of deep anesthesia proper was approximately 3 hours. Both the heart rate and the rectal temperature increased in the first 90 min after the injection of chlorpromazine and pentobarbital sodium. The rise in temperature was slight. A corneal reflex was maintained during anesthesia. The diameter of the pupil was always slightly decreased. Muscle tone was lost in 87% of the animals at 30 min and in 94% at 60 min after the injection of both drugs. Occasional localized gross movements were presented in variable degrees in 29% of the animals at 30 min and 17% of animals at 60 min following the administration of both drugs. A shorter induction time is obtainable with pentobarbital sodium by chlorpromazine premedication.

469 YOUNG, W.A. 1948. Wing amputation of birds in lieu of pinioning. J. Am. Vet. Med. Assoc. Vol. 112, p. 224.

A description on using novocaine as an anesthetic drug and the procedures necessary for wing amputation of birds in lieu of pinioning is given in this article.

470 YOUNG, W.A. 1958. Dr. Bob Knowles operates on giant fish and makes news headlines and tv. Modern Vet. Practice. Vol. 39, no. 8, p. 17.

An operation to remove a tumor was performed on a 500 lb jewfish at a Miami, Florida, aquarium while being submerged 16 feet under water in a half-million-gallon tank of water. The jewfish was fed small fish containing tranquilizers and then given a local anesthetic before the operation took place. The outcome of the operation was successful.

471 ZAUDER, H.L., and L.R. Orkin. 1959. Chamber for anesthetization of small animals. Anaesthesiology. Vol. 20, no. 5, pp. 707-709.

A chamber was developed for small animals in which volatile and gaseous anesthetics may be used. In addition, unlike many chambers that have been developed, this chamber provides constant circulation of the gases and carbon dioxide absorption. With the use of this chamber, mice may be repeatedly anesthetized to a desired depth of anesthesia using 1.5% halothane (fluothane), 6-7% diethyl ether, and 6-7% divinyl ether. Unless hypoxic concentrations are used, it is not possible to anesthetize mice with unsupplemented nitrous oxide by this technique. The chamber measures 20" X 20" X 16" internally.

APPENDIX A

ADDRESSES OF STATE

FISH AND WILDLIFE AGENCIES

ALASKA Department of Fish and Game, Subport Bldg., Juneau 99801 (tele. 907, 465-4100).

ARIZONA Game and Fish Department, 2222 W. Greenway Rd., Phoenix 85023 (tele. 602, 942-3000).

CALIFORNIA Department of Fish and Game, 1416 Ninth St., Sacramento 95814 (tele. 916, 445-3535).

COLORADO Division of Wildlife, 6060 Broadway, Denver 80216 (tele. 303, 825-1192).

FLORIDA Game and Fresh Water Fish Commission, 620 S. Meridian St., Tallahassee 32304 (tele. 904, 488-1960).

HAWAII Division of Fish and Game, 1151 Punchbowl St., Honolulu 96813 (tele. 808, 548-4000).

IDAHO Fish and Game Department, 600 S. Walnut, Box 25, Boise 83707 (tele. 208, 384-3700).

INDIANA Division of Fish and Wildlife, 608 State Office Bldg., Indianapolis 46204.

MAINE Department of Inland Fisheries and Wildlife, 284 State St., Augusta 04333 (tele. 207, 289-2766).

MARYLAND Department of Natural Resources, Tawes State Office Bldg., Annapolis 21401 (tele. 301, 269-2752).

MISSISSIPPI Game and Fish Commission, Robert E. Lee Office Bldg., 239 N. Lamar St., P.O. Box 451, Jackson 39205 (tele. 601, 354-7333).

MONTANA Department of Fish and Game, 1420 East Sixth, Helena 59601 (tele. 406, 449-2535).

NEVADA Department of Fish and Game, Box 10678, Reno 89520 (tele. 702, 784-6214).

NEW HAMPSHIRE Fish and Game Department, 34 Bridge St., Concord 03301 (tele. 603, 271-3421).

NEW MEXICO Department of Game and Fish, State Capitol, Santa Fe 87503 (tele. 505, 827-2143).

NEW YORK Division of Fish and Wildlife, 50 Wolf Rd., Albany 12233 (tele. 518, 457-5690).

NORTH CAROLINA Wildlife Resources Commission, Archdale Bldg., 512 N. Salisbury St., Raleigh 27611 (tele. 919, 733-3391).

NORTH DAKOTA State Game and Fish Department, 2121 Lovett Ave., Bismarck (tele. 701, 224-2180).

OHIO Division of Wildlife, Fountain Square, Columbus 43224 (tele. 614, 466-7313).

OREGON Department of Fish and Wildlife, P.O. Box 3503, Portland 97208 (tele. 503, 229-5551).

SOUTH DAKOTA Wildlife, Parks and Forestry Department, Sigurd Anderson Bldg., Pierre 57501. (tele. 605, 773-3485)

WASHINGTON Department of Game, 600 N. Capitol Way, Olympia 98504 (tele. 206, 753-5700).

WEST VIRGINIA Department of Natural Resources, 1800 Washington St., East, Charleston 25305 (tele. 304, 348-2754).

WYOMING Game and Fish Department, Cheyenne 82002 (tele. 307, 777-7631).

APPENDIX B

LOCATION OF SOME JOURNALS AND PERIODICALS

Denison Memorial Library
University of Colorado Medical Center
Denver, Colorado

- American Journal of Veterinary Research
- Anaesthesiology
- Applied Microbiology
- Federation Proceedings
- Laboratory Animal Science

Colorado State University Library
Ft. Collins, Colorado

- Canadian Veterinary Journal
- Copeia
- International Zoo Yearbook
- Iowa State University Veterinarian
- Journal of the American Veterinary Medical Association
- Journal of Small Animal Practice
- Laboratory Animal Care
- Laboratory Animal Science
- Modern Veterinary Practice
- Raptor Research
- Veterinary Medicine and Small Animal Clinician
- Veterinary Record
- Veterinary Medicine

Fish and Wildlife Research Library
Building 16, Denver Service Center
Denver, Colorado

- Journal of Mammalogy
- Journal of Wildlife Disease
- Progressive Fish-Culturist
- Transactions of the American Fish Society

Denver Public Library

- Journal of Mammalogy
- Journal of Wildlife Diseases
- Journal of Wildlife Management

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